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# **THE REVIEW OF APPLIED ENTOMOLOGY.**

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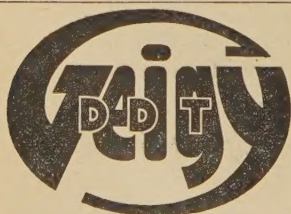
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CAMERON (A. E.), MCHARDY (J. W.) & BENNETT (A. H.). **The Heather Beetle** (*Lochmaea suturalis*).—69 pp., 13 pls., 10 graphs, 25 refs. Petworth, Sussex, Brit. Field Sports Soc. [1944.] Price 1s.

The Galerucid, *Lochmaea suturalis*, Thoms., which was destructive to ling heather (*Calluna vulgaris*) in different parts of Great Britain in 1933, increased in importance until 1937, when an investigation on its bionomics and control was begun. The results are given in detail; the following is based largely on the authors' summary. The beetle has one generation in the year [cf. *R.A.E.*, A 24 362, 642] and laboratory observations showed that there is no obligatory diapause in the life-cycle. Its activities are mainly confined to boggy moorlands; the eggs require a humid environment for development and are deposited chiefly on sphagnum moss. There is little control by natural enemies. The Tachinid, *Degeeria collaris*, Fall., was the only parasite found, and was recorded only from moors near Edinburgh. The most important predator was *Coccinella hieroglyphica*, L., but it is considered improbable that this Coccinellid could increase in numbers rapidly enough to terminate an outbreak. The principal factor that determines the rate of multiplication of *L. suturalis* appears to be rainfall in spring and early summer, when abnormally dry weather seems to be unfavourable for oviposition and egg development.

Dusts of derris or derris and pyrethrum destroyed a large proportion of the larvae when applied to infested heather in early August, but were much less effective against the adults in May and June; sprays of derris or pyrethrum gave little control of the larvae. Burning the heather in July and August (which is illegal in Scotland) controlled the larvae, but burning in spring did not affect the adults [cf. 26 418]. Heather burning has the advantage of encouraging the growth of young heather, which recovers more quickly from attack than older plants, and a rotational system of burning every ten years is recommended. Drainage is considered to be the most satisfactory and permanent method of controlling *Lochmaea*. It renders the environment less suitable for breeding, by removing excess moisture and discouraging the growth of sphagnum moss and also makes more frequent heather burning possible, so that the proportion of young heather throughout a moor may be increased.

Of other insects that attack ling heather, the Curculionid, *Strophosomus lateralis*, Payk., and the Lymantriid, *Orgyia antiqua*, L., are the most important. Other causes of injury are briefly reviewed.

HEY (G. L.). **Observations on the Life History of the Fruit Tree Red Spider and its Control.**—*Fruitgrower* 97 pp. 66, 70, 101–102, 199–200, 313–314, 387–388, 423–424, 29 refs. London, 1944.

In a short account of observations on the life-history of *Paratetranychus pilosus*, C. & F., on apple in Sussex and the eastern counties of England in 1940, 1941 and 1943 [cf. *R.A.E.*, A 29 108, 285, 286], the author reports that there were probably only three generations after the overwintered one in 1943, and hatching was spread over nearly six weeks for winter eggs, instead of about four as in 1940 and 1941, and over 28 days for eggs of the first generation instead of 19 as in 1941. Winter eggs hatched 10–15 days earlier on unsprayed trees than on those treated with tar distillate or with dinitro-ortho-cresol in petroleum oil, indicating that though these materials do not usually prevent the hatching of overwintered eggs, they may delay it. The mite was found on blackthorn [*Prunus spinosa*], crab-apple, elm, hawthorn [*Crataegus*] and walnut as well as apple, pear and plum, but the author considers that late infestation in Essex is not due to migration from wild food-plants [cf. 32 82] as these are seldom heavily infested there and are scarce or absent near many orchards.

Brief notes are given on other mites that are sometimes confused with *P. pilosus* and on its natural enemies. It appeared to have no parasites, but the Capsids, *Blepharidopterus (Aetorhinus) angulatus*, Fall., *Capsus (Heterotoma)*

*meriopterus*, Scop., *Phytocoris tiliae*, F., *Orthotylus marginalis*, Reut., *Atractotomus mali*, Meyer, *Plagiognathus arbustorum*, F., *Deraeocoris* (*Capsus*) *ruber*, L., *Malacocoris chlorizans*, Panz., and possibly *Psallus ambiguus*, Fall., were found feeding on the mites or their summer eggs. *Anthocoris nemorum*, L., and possibly other species of *Anthocoris* are also predacious on the mite, but none of these insects, with the possible exception of *Blepharidopterus*, is numerous enough in orchards that are sprayed in winter to have much effect on the mite population, and *Blepharidopterus* seldom appears until late June, by which time infestation is usually serious.

If infestation does not develop until mid-August, the trees are apparently not much affected, but when it becomes heavy in June or July, there is generally premature defoliation, the fruit matures late and is small and green, and the trees sometimes fail to blossom in the following year. *P. pilosus* is usually of more economic importance on dessert apples than on cooking varieties, and most of the apple orchards in Essex, Suffolk, Sussex and parts of Cambridgeshire and Kent suffer from very severe infestations. The mite occurs to some extent in all the fruit-growing areas of Great Britain, though it is rarely numerous in orchards that are severely attacked by the apple Capsid [*Plesiocoris rugicollis*, Fall.].

The author discusses the resistance of the mite to various sprays and the possibility that more resistant strains are developing, and gives details of the results obtained with winter and summer sprays in commercial orchards in Essex in 1943. Dormant sprays of tar distillate were followed by heavy infestation; the best control resulted from an application of petroleum oil between the green-tip and delayed-dormant stages, whether or not it followed tar distillate, or from one of thiocyanate in petroleum at this time, the trees being practically free of mites until late July or August. The sprays have the disadvantage of delaying the development of the buds, particularly if closely followed by lime-sulphur, and frosts are considered to be more injurious to trees that have received petroleum oil and lime-sulphur than to those receiving lime-sulphur only; further tests on the efficiency of petroleum oils applied at different times between December and the delayed dormant stage are desirable. Summer sprays afford only a very temporary check to infestation, since it is practically impossible to wet all the leaves on their lower surfaces, where the mites occur. Lime-sulphur (1 : 100) with a wetting agent and derris extract without oil were both ineffective, but sprays of derris extract in oil killed most of the mites that were hit and some of the eggs. White oil (1 : 100) gave good control in one test, but is liable to cause leaf and fruit injury in the eastern counties.

KELSEY (J. M.). **The Identification of Termites in New Zealand.**—*N.Z.J. Sci. Tech.* **25** B no. 6 pp. 231–260, 29 figs. Wellington, 1944.

The author gives a key to the families, genera and species of termites that have been recorded from New Zealand; they comprise the two native species, *Kaloterme* (*Caloterme*) *brouni*, Frogg., and *Stoloterme ruficeps*, Brauer, and eight others introduced in timber from Australia. Of these, *Coptoterme acinaciformis*, Frogg., *C. lacteus*, Frogg., and *C. frenchi*, Hill [cf. *R.A.E.*, A **30** 564; **32** 336] are common, *Poroterme adamsoni*, Frogg., and *K. (Caloterme) insularis*, Wlk., have been recorded three or more times, and *K. (C.) tuberculatus*, Frogg., *K. (C.) condonensis*, Hill, and *Eutermes walkeri*, Hill, are represented by single records. He also gives additional information on characters distinguishing the species of *Coptoterme* from one another, though he considers these doubtfully distinct, and details of the localities in which the introduced termites have been found, describes the alates and soldiers of *S. ruficeps*, *Coptoterme acinaciformis*, *C. lacteus* and *C. frenchi*, and the workers of the genus

*Coptotermes*, the soldiers and workers of *Eutermes walkeri* and the alates, soldiers and nymphs of *Kalotermes tuberculatus*, *K. brouni*, *K. condonensis*, *K. insularis*, and *P. adamsoni*.

MILLER (L. W.). **Investigations of the Flour Beetles of the Genus *Tribolium*.**

**II. Effect of different Mill Fractions on the larval Development and Survival of *T. castaneum* (Hbst.) and *T. confusum* (Duv.).**—*J. Dep. Agric. Vict.* 42 pt. 8 pp. 365–373, 377, 5 graphs, 29 refs. Melbourne, 1944.

Since the type of food available might be one of the factors responsible for the predominance of *Tribolium confusum*, Duv., in flour mills in Victoria, and that of *T. castaneum*, Hbst., in wheat [cf. *R.A.E.*, A 33 129], experiments on the effect of different diets on the development and survival of larvae of the two species were begun in 1942. Adult beetles were left in flour for several hours, after which the eggs laid were recovered and kept in an incubator until they hatched. The larvae were transferred to glass vials with each of six mill stocks obtained from different machines in a flour mill during the gristing of a uniform grade of wheat, and the resulting pupae were recorded, examined as to sex and kept under regular observation until the adults emerged. At 20°C. [68°F.] and 75 per cent. relative humidity, the egg and pupal stages averaged 4 and 5.5 days, respectively, for *T. castaneum* and about 5 and 6.5 days for *T. confusum*, no effect that could be attributed to diet being observable in the pupal periods. Complete development lasted 23–63 days for *T. castaneum* and 27–69 days for *T. confusum*, the wide variation being due chiefly to differences in the rate of larval development on the different foods. The larval stages of both species were much longer on the least nutritive food (white flours) than on the more nutritive ones (crushed wheat and pollard), probably because of the deficiency of some or all of the B-complex vitamins [cf. 32 185]. The effect of low nutrition was more marked in the case of *T. castaneum*, the duration of the larval stage being significantly shorter than that of *T. confusum* on the more nutritive diet, but the same on white flour. Larval survival of both species was much lower on the latter, but the percentage survival of *T. castaneum* was significantly lower than that of *T. confusum* on this food; in two of the more nutritive diets the percentage of survivors was the same, and on a diet of crushed wheat it was greater for *T. castaneum*. It appears, therefore, that *T. castaneum* is the more sensitive to the nutritive value of its food and that flours of the type tested were not satisfactory for its optimum growth and survival. No relationship was established between nutrition and sex, and the similarity in the general food responses of the two species suggested that intracellular symbionts were as unimportant in the nutrition of *T. castaneum* as they are in that of *T. confusum* [cf. 32 186].

It is concluded that the environment within a flour mill would favour the larval development and survival of *T. confusum* more than that of *T. castaneum*.

COTTON (R. T.), BALZER (A. I.) & FRANKENFELD (J. C.). **Control of Mill Insects.**—*Amer. Miller* April 1944. Repr. in *Pests* 12 no. 8 pp. 16–18, 1 graph. Kansas City, Mo., 1944.

The authors give figures showing the numbers of insects, chiefly species of *Tribolium*, found in samples of stock taken in flour mills in the United States at different times of the year and at different periods following fumigation. Available evidence indicates that reinfestation is due mainly or entirely to the breeding of insects that survive fumigation, the introduction of insects with the in-coming grain being of little or no importance. To determine the possibility of keeping infestations at a safe level between general fumigations, a modern concrete flour mill consisting of two units was fumigated with liquid hydrocyanic acid in October 1942, and one unit was fumigated locally with a mixture of ethylene dichloride and carbon tetrachloride (3 : 1) four weeks later and then at intervals

of three weeks throughout the winter and spring. Only the conveyors were treated, the metal elevator boots being cleaned out occasionally as routine procedure in both units. The average numbers of insects in 8-oz. samples taken from milling streams in the untreated and treated units at various intervals after the general fumigation were 1 and 1 after both 4 and 7 weeks, 4 and 2 after 10 weeks, 13 and 2 after 13 weeks, 32 and 6 after 18 weeks, 31 and 2 after 21 weeks, 31 and 12 after 24 weeks and 75 and 18 after 27 weeks. In the following summer, between general fumigations with HCN in July and October, both units were locally fumigated with the mixture every three weeks, the stock in the elevator boots being removed at the same time. The average numbers of insects in 8-oz. samples taken before each local fumigation, 3, 6, 9 and 10 weeks after the first general fumigation, were 2, 1, 7 and 3 in one unit and 0.4, 3, 8 and 2 in the other, and no reports of insect infestation in flour from this mill were received during the year.

The sifters were not treated during these tests, and it is believed that infestations developing in these machines were probably responsible for the large numbers of insects occasionally found in some of the elevator boots. It is therefore recommended that sifters should be treated occasionally.

COTTON (R. T.), WALKDEN (H. H.) & SCHWITZGEBEL (R. B.). **The Role of Sorption in the Fumigation of stored Grain and milled cereal Products.**—*J. Kans. ent. Soc.* **17** no. 3 pp. 98-103, 1 ref. Manhattan, Kans., 1944.

It has long been recognised that a much higher concentration of most fumigant gases is required to kill insects in a given time in a container filled with grain or flour than in an empty one, owing to sorption of the gas by the product. Experience has shown, however, that the vapours sorbed by cereal products can be used to extend the period of fumigation until a satisfactory kill of the insects is obtained. In experiments described, adults of *Tribolium confusum*, Duv., were buried in the middle of bags of flour, the flour was fumigated by means of liquid hydrocyanic acid, and the beetles were removed, some immediately and some after 48 hours' exposure to the action of the sorbed gas. When the flour was treated by vacuum fumigation with 30 minutes' exposure to a dosage that would require three hours to be effective, the beetles removed immediately were all alive, but those removed after 48 hours showed a mortality of 83.4 per cent. In three experiments in which the bags of flour were subjected to overnight fumigation under atmospheric conditions in a concrete vault with dosages corresponding to 1.3, 1.75 and 2.2 lb. per 1,000 cu. ft. and 0.18, 0.33 and 0.31 lb. per 1,000 lb. flour, the mortality percentages rose from 41.6, 36.6 and 58.3, respectively, in beetles taken from the bags when they were removed from the vault, to 66.6, 95.0 and 100 in those left in the flour for 48 hours. A. I. Balzer found that rice fumigated for 15 minutes in a vacuum chamber by means of liquid hydrocyanic acid at a dosage of  $1\frac{1}{4}$  oz. per 1,000 lb. retained enough gas to cause 99.4 per cent. mortality of adults of the rice weevil [*Calandra oryzae*, L.] left in it for 72 hours, though those removed immediately were not affected.

Since it has recently been found that fumigation in tightly-caulked steel bins at dosages known to be safe for ordinary exposures impairs the germinating powers of wheat, the length of time for which effective concentrations are maintained was investigated by introducing insects into fumigated wheat in bins at weekly intervals and determining the mortality after five or six days. The period of effectiveness was found to depend on the nature of the fumigant; and to vary directly with the volume of fumigant applied and inversely with the temperature of the grain. A mixture of ethylene dichloride and carbon tetrachloride (3:1) is generally applied in larger quantities than other fumigants; when it was applied at rates of 4-6 U.S. gals. per 1,000 bushels wheat, the sorbed gas killed insects for as long as 16 weeks. This is of value in protecting wheat in bins from infestation by migrating insects in late summer and

early autumn, when the grain temperatures are high enough to permit breeding. Infestations developing in wheat in bins fumigated with the mixture late in August in Kansas were controlled, and the fumigant remained effective until the end of the warm weather, when breeding ceased.

Because of their retention by the wheat in steel bins, fumigants that were hitherto considered to be insufficiently toxic can be successfully used. Carbon tetrachloride used alone at a dosage of 3 U.S. gals. per 1,000 bushels wheat in caulked steel bins consistently gave complete mortality of all stages of insects in a week. Wheat that was exposed for three days to carbon bisulphide applied at a dosage of 2 U.S. gals. per 1,000 bushels and was then transferred to another bin retained enough of the fumigant to give 99 per cent. mortality of insects that were distributed throughout it on the day after transfer and removed three days later. The loss of baking qualities in flour prepared from wheat fumigated in bins appears to be slight, but germination of wheat was impaired by mixtures containing carbon bisulphide, chlorpicrin and 1, 1-dichloro-1-nitroethane and by carbon tetrachloride used alone. The mixture of ethylene dichloride and carbon tetrachloride did not appear to affect germination, but when it was used with the addition of 10 per cent. methyl bromide to fumigate wheat in a number of caulked steel bins holding 2,740 and 1,000 bushels in North Dakota, successive applications being made in November 1941, August 1942 and September 1943 at the rate of 2 U.S. gals. per 1,000 bushels, the average viability of the grain decreased from 91.4 to 22.4 per cent. in the large bins and from 92 to 39 per cent. in the smaller ones; the corresponding decreases in the controls were from 92.6 to 84 per cent. and from 90.5 to 88 per cent. The viability of the fumigated wheat decreased more rapidly in the large bins than in the smaller ones.

Maize in uncaulked steel bins does not appear to retain fumigants for long; no loss of viability in shelled maize was observed in germination tests.

DUCK (L. G.). *The Bionomics of Schistocerca obscura* (Fabr.).—*J. Kans. ent. Soc.* 17 no. 3 pp. 105–119, 16 refs. Manhattan, Kans., 1944.

During a recent outbreak of grasshoppers in Oklahoma, *Schistocerca obscura*, F., became unusually abundant and caused some damage of minor economic importance. All stages of this Acridid are described, its distribution is reviewed and the results are given of investigations on its bionomics, carried out from June 1938 to July 1939. In the field, the nymphs fed on low scrubby elm growth from the time they hatched in spring until they became adult, and the adults fed chiefly on elm and on maize and cotton in neighbouring fields. They were constantly moving between the crops and the elm, but did not attack the maize until it was five feet high and migrated to the cotton when the maize became dry. In late autumn, they attacked young wheat if it was near sites suitable for oviposition. Food-preferences were similar under cage conditions; the adults preferred elm and cotton, and fed on green mature maize, persimmon (*Diospyros virginiana*) and wheat more readily than on many other plants offered to them; they did not feed at all on young maize or grasses of various genera.

In greenhouse experiments, in which elm was the principal food, pairing and oviposition occurred, on an average, 18 and 44.1 days, respectively, after the females became adult. The intervals between the deposition of the first and second and the second and third egg-pods were 5–11 and 9–21 days, respectively, and the number of eggs per pod in first, second and third pods averaged 75.4, 42 and 31. The duration of the egg stage in days and (in brackets) the percentage of eggs that hatched averaged 261.3 (50.3) at outside temperatures and 83.1 (10.87) at about 68°F. The duration of the nymphal stage averaged 46.1 days at 89.9°F., 51.2 days at 85°, and 51.5 days out of doors; nymphs reared at 70°F. were in the fifth instar at the end of the investigation, and the rate at which they had developed indicated that much more time would be

required at this temperature. Nymphs reared at low temperatures and under crowded conditions were considerably darker in colour than isolated individuals reared at higher temperatures; population density appeared to exert a greater influence than temperature on coloration. This change is believed to show a tendency for the species to assume a partial migratory phase.

BROWN (R. C.) & SHEALS (R. A.). **The present Outlook on the Gypsy Moth Problem.**—*J. For.* 42 no. 6 pp. 393-407, 9 figs., 16 refs. Washington, D.C., 1944.

This paper contains a comprehensive summary of the position as at February 1944 of the problem of *Lymantria* (*Porthetria*) *dispar*, L., and its control in the north-eastern United States and lines of research and control that were proposed for the immediate future [cf. *R.A.E.*, A 30 463]. The history of the moth in the United States, the damage it has caused there and the influence of forest composition and the physical factors of the environment on its abundance are discussed, and lists are given of the species of trees that are highly attractive to both young and older larvae, those that are less attractive but are attacked by both, those that are attractive only to the older larvae, and those that are unattractive to larvae of any age. The importance of silvicultural measures of control is emphasised [cf. 32 239].

Parasites of *L. dispar* have been introduced into the United States from several European countries and Japan since 1905, and ten species are known to have become established. Investigations on the degree of parasitism and the host population in selected plots in various forest regions in New England, carried out in 1929-34, showed that the percentage parasitism by the principal egg parasite, *Anastatus disparis*, Ruschka, was highest in the heavier infestations of the regions of pine and oak, and of white pine; the most important larval parasite, *Compsilura concinnata*, Mg., was most effective in the lightly infested central hardwoods region, and in parts of the white-pine region where infestation was relatively light; and the principal pupal parasite, *Sturmia scutellata*, R.-D., maintained a fairly high average percentage parasitism, regardless of host density or forest region, except in the pine-oak region. The maximum percentages of parasitism observed for these species in any year were 41.2 for *Anastatus*, 57 for *Compsilura* and 74.5 for *Sturmia*; these are much higher than the average percentages. In the past few years two other introduced parasites, *Phorocera* (*Parasetigena*) *silvestris*, R.-D., and *Tachina* (*Exorista*) *larvarum*, L., have been recovered for the first time in appreciable numbers. The effectiveness of parasites in controlling *L. dispar* is difficult to evaluate, but there are indications that *Compsilura* and *Sturmia*, by killing appreciable percentages of the host when its population is low, give considerable control in the central hardwoods region. Other natural enemies are the imported predator, *Calosoma sycophanta*, L., which destroys large numbers of larvae and pupae, and a virus causing wilt disease.

In reviewing recent attempts to develop more efficient control by means of insecticides, the authors state that small-scale tests on the minimum concentration of lead arsenate effective against the larvae have indicated that a concentration of 5 lb. per 100 U.S. gals. water is only slightly more effective than one of 2 lb., and discuss the advisability of applying concentrated sprays or oil-coated dusts from aircraft [cf. 27 645; 28 182; 29 412] and the possibility of replacing lead arsenate by materials less poisonous to man [cf. 31 465], mentioning preliminary tests in which pyrethrum in aerosol form proved toxic to the larvae, particularly those in the early instars.

The importance of surveys to detect new infestations, particularly west of the barrier zone, is pointed out; they are greatly facilitated by the use of traps containing extracts of the females to attract the males [cf. 21 459, etc.].

The traps are usually put  $\frac{1}{2}$ –1 mile apart along roadsides where favoured food-plants occur, and should be examined at least once a fortnight. Recent investigations have shown that the attractiveness of the extract can be increased by chemical treatment [cf. next abstract].

Changes in control work have been made necessary by the discontinuance of the federal relief programme, the scarcity of labour and of important supplies, and other considerations. In the barrier zone, suppressive measures are being applied only in areas where infestations are considered likely to spread into uninfested localities. The trap survey is to be expanded considerably, and inspection in areas known to be infested will be largely restricted to a rapid type of survey conducted by experienced workers. Cryolite was to be used extensively in 1944 to replace lead arsenate, because it was not so scarce and is less dangerous to livestock.

HALLER (H. L.), ACREE JR. (F.) & POTTS (S. F.). **The Nature of the Sex Attractant of the Female Gypsy Moth.**—*J. Amer. chem. Soc.* **66** no. 10 pp. 1659–1662, 10 refs. Easton, Pa., 1944.

Benzene extract prepared from the abdominal tips of unfertilised females of *Lymantria* (*Porthetria*) *dispar*, L., are used in the United States to attract the males [cf. preceding abstract, etc.]. Work on the chemical nature of the attractant was resumed in 1941, and field tests were carried out in the flight seasons of 1942 and 1943 in which the attractiveness of various fractions of benzene extractives obtained from females taken in the preceding year were compared with that of the extractives themselves. The ways in which the fractions were prepared are described, and the catches with them are given. The results showed that the attractant contains no free acidic or basic groups and is found in the unsaponifiable fraction after the benzene extractive has been refluxed with dilute ethanolic potash. Treatment with catalytic hydrogen markedly increases its attractiveness. It is specific for males of *L. dispar*; none of several synthetic materials tested showed any attractiveness.

PEPPER (B. B.) & HAENSELER (C. M.). **Control of European Corn Borer and Ear Smut on Sweet Corn with Dusts and Sprays.**—*Circ. N. J. agric. Exp. Sta.* no. 486, 14 pp. New Brunswick, N.J., 1944.

Early varieties of sweet maize, which are those largely grown in New Jersey, are highly susceptible to attack by *Pyrausta nubilalis*, Hb., and ear smut (*Ustilago zeae*), and information is given in this circular on these pests and their control. The bionomics of *P. nubilalis* in that State [cf. *R.A.E.*, A **28** 175] and the cultural measures used against it are briefly reviewed. The latter include destroying all crop remnants while the larvae or pupae are in them, timing the planting of sweet maize so that the ears mature between the two main broods of borers (between about 25th July and 20th August in the central part of the State) and planting large-stalked varieties for late maize rather than the small-stalked varieties, which are less able to support large populations of larvae without suffering reduced yields.

Experiments and field demonstrations have shown that insecticides can be used profitably to protect early sweet maize, but are less effective against larvae of the second generation and may not give a commercial profit on mid-season and late varieties. Sprays of 4 lb. derris or cubé, containing not less than 4 per cent. rotenone, or of 1 lb. nicotine sulphate and 4 lb. dry Wyoming bentonite clay, per 100 U.S. gals. water, each with 5 oz. wetting agent, applied at the rate of 100–125 U.S. gals. per acre, and dusts of finely ground derris or cubé (5 per cent. rotenone), dusting sulphur and talc or clay (20 : 25 : 55), nicotine-bentonite concentrate (14 per cent. fixed nicotine), dusting sulphur and walnut-shell flour or talc (28 : 25 : 47), or finely ground derris or cubé, nicotine-bentonite concentrate, dusting sulphur and talc or clay (10 : 14 : 25 : 51),

each with 2 oz. wetting agent per 100 lb., applied at about 35 lb. per acre, are effective against *P. nubilalis* and have given good control of the fungus, though their mode of action on the latter is not well understood. The only wetting agents tested that have given consistently satisfactory results without plant injury are Vatsol OS (a sodium salt of an alkyl naphthalene sulphonic acid) Areskap (sodium monosulphonate of butylphenylphenol) and Ultrawet (aromatic monosodium sulphonate). The sulphur is essential in the last dust mixture to prevent the nicotine from destroying the rotenone; it can be replaced by talc, walnut-shell flour or clay in the other two dusts, but they are then somewhat less effective against the fungus. The first application of spray or dust should be made when the first egg-masses in the field begin to hatch, and this should be followed by three additional ones at intervals of five days against the first generation and by at least four at the same intervals against the second. The insecticide should be directed into the open whorls when the plants are in the pre-tassel stage and on the opening tassels and the ear shoots when the latter begin to form; when the tassels are fully open they are unattractive to the larvae and need not be dusted.

LLOYD (D. C.). **A Study of the Codling Moth and its Parasites in California.**—*Sci. Agric.* **24** no. 10 pp. 456-473, 33 refs. Ottawa, 1944.

In connection with a programme for the biological control of *Cydia pomonella*, L., in Canada, a survey of natural enemies of the larvae and pupae of this moth in California was made in 1941. That State was selected because it has a rich fauna, and it was thought that native parasites and predators might effect a high degree of control of an introduced pest such as *C. pomonella*. A brief account is given of the bionomics of the moth in California, where in addition to apple and pear it also infests walnuts and stone fruits, the areas in which the investigations were carried out, chiefly apple and walnut orchards, are shown on a map, the methods adopted are described, and the results are shown in tables and discussed. They indicated that the only parasites of any importance were a species of *Ascogaster*, which predominated in summer and winter but is not native to the State and was observed only in apple orchards, *Mastrus* (*Aenoplex*) *carpocapsae*, Cushm., and *Lixophaga orbitalis*, Aldr., but none was effective enough to warrant much consideration in a control programme. The author considers the species of *Ascogaster* to be *A. quadridentata*, Wesm., regarding *A. carpocapsae*, Vier., as identical [but cf. R.A.E., A **32** 263]; the latter was recorded from *C. pomonella* in California by Hensill [**21** 470]. Other parasites found were *Mastrus pilifrons*, Prov. (*Aenoplex betulaeicola*, Ashm.), of which *A. plesiotypus*, Cushm. [**13** 127; **14** 637] is a synonym, *Anachaetopsis tortricis*, Coq., *Pimpla* (*Ephialtes*) *sanguinipes*, Cress., *Macrocentrus ancylovorus*, Rohw., which has spread into northern California from Oregon, *Dibrachys cavius*, Wlk., and an undescribed species of *Ischnus*. All these parasites were primary, but *D. cavius* also developed as a parasite of *Ascogaster*.

No quantitative work on predators was attempted, but it was observed that larvae of the Clerids, *Cymatodera* sp. and *C. ovipennis*, Lec., were active throughout the winter, that another Clerid, *Hydnocera scabra*, Lec., occurred in several walnut orchards and some apple orchards [cf. **14** 638], and that larvae of an unidentified Raphidiid were common throughout the sampling areas. The Raphidiid and the species of *Cymatodera* destroyed large numbers of the larvae and pupae of *Cydia* in trap bands in some orchards.

Some of the orchards examined had been untreated for 15 years, yet the populations of the few native natural enemies were very low, whereas the population of *Cydia pomonella* was relatively high and the moth caused considerable annual crop losses. Though of sporadic distribution, *Ascogaster* is probably the most effective larval parasite in the State; *Lixophaga* did not build up appreciable populations during the season of 1941, though it was present

early in the year in most areas investigated, and there is reason to believe that it is already exerting its maximum effect on the host. *Mastrus* spp., which are ectoparasitic on the host larvae in their cocoons, are not well adapted to exercise appreciable control because most individuals diapause in the larval stage in July, August and early September, when *C. pomonella* is rapidly increasing and doing economic damage; also the very low incidence of these Ichneumonids on the summer generation of *C. pomonella* suggests that other hosts may be utilised at this time.

The results of the more detailed investigations on the natural enemies of the moth in Canada and the United States since about 1910 are summarised for comparison with those obtained in this work. In the lack of effective control by native parasites and predators, California appears to be similar to other parts of North America. There is some evidence that under favourable conditions, parasitism of the eggs by species of *Trichogramma* becomes high late in the season in a few areas in the United States, but for satisfactory control these parasites should destroy a high proportion of the eggs when the host populations are low, and they are apparently unable to do this. The action of the native larval and pupal parasites is even more unsatisfactory, since there is no evidence that they destroy a high proportion of the host even when it is abundant. On the basis of published data and the present survey it appears that these species are little more than casual enemies of *C. pomonella*, and in view of the long period during which the latter has been a pest in North America, there is no reason to expect any improvement.

*Mastrus carpocapsae* is as abundant in some of the eastern States as in California, and as there are no obvious geographical barriers to its spread into Canada, its absence or extreme rarity there is probably due to some other natural factors, and it is doubtful if any useful purpose would be served by liberating colonies in eastern Canada. Since there is considerable taxonomic confusion regarding the identity of the species of *Lixophaga* that have been reared from *C. pomonella* in the eastern and western districts, it is possible that *L. orbitalis* is already present, though less abundant, in the eastern States, and its liberation in Canada might be worth attempting. The Clerid and Raphidiid predators have not been found in the Niagara district, and these also deserve consideration for introduction.

SMITH (R. F.) & MICHELbacher (A. E.). **Clover Leaf Weevil in California.**—*Pan-Pacif. Ent.* **20** no. 3 p. 120. San Francisco, Calif., 1944.

*Hypera punctata*, F., occurs in both cultivated and uncultivated areas of California. Although there is relatively little cultivated clover in the State, the spring generation is common on *Melilotus* and other wild clovers. The weevil has been recorded on lucerne in seven counties and is likely to occur on this crop anywhere in northern and central California and in some parts of southern California, but it has not caused economic damage. Climatic conditions in spring are apparently so favourable for the development of a fungous disease [cf. R.A.E., A **31** 512] that it is usually controlled before it causes serious damage.

BUGBEE (R. E.) & REIGEL (A.). **The Cactus Moth, *Melitara dentata* (Grote) and its Effect on *Opuntia macrorrhiza* in western Kansas.**—*Amer. Midl. Nat.* **33** no. 1 pp. 117–127, 8 figs., 6 refs. Notre Dame, Ind., 1945.

Recent observations have shown that some reduction in stands of the prickly-pear cactus (*Opuntia macrorrhiza*) on range lands in western Kansas and eastern Colorado is brought about by insects, and a survey in western Kansas in 1940–41 indicated that insects had killed many clumps in the former area, which

were being replaced by short grasses. One of the insects concerned was *Melitara dentata*, Grote [cf. *R.A.E.*, A 32 263], and since a request was made for a consignment of this Pyralid to be sent to California for investigation there, with a view to its release against a species of *Opuntia*, observations on its life-history in Kansas were made in 1942-43. The egg, larva and pupa are described. Adult emergence began in late June in the laboratory, but was at its height in the field in July and August, gradually decreasing in September and October. The adults, which are nocturnal in habit, survived for an average of five days in the laboratory. The eggs were deposited on the ends of the spines and hatched in about eight days. The larvae fed for two or three days on the epidermis of the pads, which they covered with webbing, and then tunnelled into the pads and fed on their contents. They overwintered in the pads in a more or less dormant condition until mid-April, when they resumed continuous feeding and, having exhausted the contents of one pad, migrated to others. Any fruits present were also attacked. Between late July and early September, the larvae pupated in cocoons under dried pads next to the ground, the pupal stage averaging 23 days. Some of the larvae in the pads were attacked by a fungous disease.

These results differed in some respects from those recorded by Cook [30 426], which are summarised, but since larvae kept in the laboratory remained active throughout the winter and became full-fed by early June, a month before those in the field, it is considered possible that the moth may overwinter in either the egg or the larval stage, depending on the temperature in autumn.

No figures are available for the amount of destruction of the cactus caused by *M. dentata*, but in the area under observation, 50-75 per cent. of the clumps in some of the well-managed pastures were attacked. The percentage was much lower in overgrazed pastures [cf. 30 426]. It is concluded that, given adequate cover and sufficient rainfall, the moth acts as a material check on the cactus in the short-grass range lands.

CHRISTENSEN (J. R.). **Estudio sobre el género *Diabrotica* Chev. en la Argentina.**  
—*Rev. Fac. Agron. U. C.* 19 no. 3 pp. 464-516, 32 figs., 22 refs. Buenos Aires, 1944.

The author gives characters by which different groups of genera of Galerucids can be distinguished, describes the genus *Diabrotica* and the species of it that occur in Argentina, including twelve new ones, gives a key to the Argentina species and discusses their distribution, the identity of some of them and the damage they cause. Lists of food-plants are given, mainly from the literature, and brief recommendations are made for the control of members of this genus. They prefer a warm or moderately warm climate, and tolerate a wide range of humidity, though they are probably unable to survive in large numbers at atmospheric humidities of about 90 per cent., as they are very susceptible to attack by entomogenous fungi.

*Diabrotica speciosa*, Germ., is the most harmful species in Argentina, its distribution coinciding almost exactly with that of the principal vegetable and fruit crops, and a list is given of the plants attacked. The larvae feed on the roots of their food-plants, which include maize and ground-nuts, and the adults on the leaves, flowers and even the fruits of plants belonging to many families, including fruit trees. There appear to be three generations in the year in the region of Buenos Aires, but the length of adult life and of the oviposition period made this difficult to determine. The winter is passed in the adult stage, and oviposition begins in spring, the eggs hatching in about ten days. *D. speciosa* was attacked by entomogenous fungi and by the Tachinid parasite, *Celatoria bosqi*, Blanch. [cf. *R.A.E.*, A 26 689], which occurred only in small numbers, though it is said to be of greater importance further north.

WOLCOTT (G. N.) & MARTORELL (L. F.). **Natural Parasitism by *Trichogramma minutum* of the Eggs of the Sugar-cane Moth Borer, *Diatraea saccharalis*, in the Cane Fields of Puerto Rico.**—*J. Agric. Univ. P. Rico* **27** no. 2 pp. 39–83, 1 fig., 6 fldg. pls., 14 refs. Rio Piedras, P.R., 1944.

The detailed results are given of field observations in 1936–41 on the natural parasitism of eggs of *Diatraea saccharalis*, F., on sugar-cane by *Trichogramma minutum*, Ril., made at 16 coastal localities in Porto Rico in order to determine the optimum conditions for releasing laboratory-reared parasites [cf. *R.A.E.*, A **32** 53]. The following is based on the authors' conclusions. The initiation of waves of abundance of egg-clusters of the host each spring in the north-western corner of the island is seasonal, but their intensity, duration and sudden termination in late summer are dependent on natural control by *T. minutum*. In the remaining four-fifths of Porto Rico, the factors responsible for the initiation, intensity and duration of the waves are not seasonal, but apparently depend on temporary and partial failure of biological control in previous generations of the host. The waves are usually much shorter in duration than those in the north-west, and, in consequence, natural control in the egg stage rarely occurs, even though ants (*Monomorium carbonarium ebeninum*, Forel) frequently eat almost as many egg-clusters as are attacked by parasites. Irrigation so modifies humidity that rainfall, varying from less than 30 to nearly 90 inches per year, cannot be proved to be a factor, and the variations in temperature are within too narrow limits to produce an effect. Height of cane and variety have no effect on the numbers of egg-clusters, but average abundance of host eggs and degree of parasitism are higher on ratoon cane than on plant cane or ratoon cane of which the trash has been burnt [cf. *loc. cit.*].

WOLCOTT (G. N.) & MARTORELL (L. F.). **The seasonal Cycle of Insect Abundance in Puerto Rican Cane Fields.**—*J. Agric. Univ. P. Rico* **27** no. 2 pp. 85–104, 12 figs., 16 refs. Rio Piedras, P.R., 1944.

The following is largely based on the authors' summary. Five years' observations in fields of young sugar-cane in Porto Rico indicated a marked seasonal abundance of the larvae of *Laphygma frugiperda*, S. & A., *Mocis repanda*, F., *Panoquina nyctelius coccinia*, H.-S., *P. nero*, F., *Perichares coridon*, F., and *Marasmia trapezalis*, Gn., during autumn and early winter. *Sipha flava*, Forbes, was most abundant during winter and in late spring, particularly in eastern Porto Rico. The eggs of *Diaprepes abbreviatus*, L., were most abundant in June and September, and on the south coast were found only during these months. The predacious Coccinellid, *Chilocorus cacti*, L., which was introduced against the scale insects attacking bamboo [cf. *R.A.E.*, A **28** 493], fed on many other Coccids, including *Pseudoparlatoria ostreata*, Ckll., on papaya, *Aspidiotus destructor*, Sign., on coconut, *Unaspis (Chionaspis) citri*, Comst., on *Citrus* and *Saissetia coffeae*, Wlk. (*hemisphaerica*, Targ.) on pigeon peas [*Cajanus cajan*], and was sometimes found in cane fields, though it is not known that it fed there. The injury caused to sugar-cane by *Paratetranychus (Tetranychus) sacchari*, McG. [cf. **31** 455] was found to resemble mosaic disease [*Marmor sacchari* of Holmes].

WOLCOTT (G. N.). **How to make Wood unpalatable to the West Indian Dry-wood Termite, *Cryptotermes brevis* Walker. II. With organic Compounds.**—*Caribb. Forester* **5** no. 4 pp. 171–180, 2 refs. Rio Piedras, P.R., 1944. (With a Summary in Spanish.)

An account is given of further investigations in Porto Rico [cf. *R.A.E.*, A **32** 29] to test the effectiveness of various organic compounds, notably the primary constituents of coal-tar creosote, in killing and repelling *Kaloterms (Cryptotermes) brevis*, Wlk., when pieces of the wood of *Bursera simaruba* were

impregnated with them. The solvents used did not themselves affect repellency. Most of the creosote derivatives tested, including naphthalene, were toxic, but too volatile to protect wood permanently. The most promising at great dilutions were phenanthrene, fluoranthene, pyrene and phenol, but only the last is sufficiently cheap and available to be of practical use. A 1 per cent. solution in petroleum ether and a 2 per cent. solution in water were ineffective, but a 2 per cent. solution in petroleum ether afforded protection for three months [cf. next abstract]. It is concluded that the known effectiveness of creosote is due to the combined action of all its constituents, the immediate toxic effect being due to the naphthalene and the more persistent repellent effect to the phenanthrene and phenol (of which undiluted creosote contains averages of 4 and 0.7 per cent., respectively) and the small amounts of fluoranthene and pyrene present. Wood impregnated with a 2 per cent. solution of a proprietary preparation containing 5 per cent. pentachlorophenol was not attacked, and wood treated with a solution containing 5 per cent. pentachlorophenol dissolved in petroleum ether remained resistant for many weeks; a 0.2 per cent. solution was neither repellent nor toxic. Wood impregnated with 1 per cent. 2, 2-bis (parachlorophenyl)-1, 1, 1-trichlorethane (DDT) in petroleum ether was very repellent and toxic for a few weeks, but was readily attacked thereafter.

A commercial preparation (Fermate) containing ferric dimethyl-dithiocarbamate protected wood treated with solutions in acetone at 0.1 or 0.2 per cent., probably by means of the ferric iron present, since a solution of ferric chloride containing 0.2 per cent. iron is also effective. In tests of copper naphthenate in petroleum ether or a similar solvent, wood treated with a solution containing 0.05 per cent. metallic copper was attacked to only a slight extent at the end of a month, and that treated with a solution containing 0.1 per cent. metallic copper, which is rather less than the concentrations in the solution of copper sulphate that gives permanent protection [cf. 32 30], remained immune and repellent until the end of the investigations. After the organic constituent of this material has volatilised, the copper remains precipitated on and in the wood, and wood treated with it remained resistant even after being soaked in water for 24 hours.

Tests were also carried out with substances occurring naturally in resistant woods. Wood treated with a solution containing 5 per cent. cedar oil in petroleum ether was resistant throughout the experiments, and that treated with a 2 per cent. solution was attacked only with reluctance. Pine oil at a concentration of 10 per cent. was ineffective. Gum obtained from the very resistant *Guaiacum sanctum* and *G. officinale* was of little value, and its effectiveness in the heartwood of these trees is thought to be due to its uniform distribution. An oil obtained from the husks of nuts of the cashew tree (*Anacardium occidentale*) prevented attack at concentrations of 1 and 2 per cent. in benzene, and wood treated with a 5 per cent. solution was protected throughout the test and retained a pronounced odour for some months. H. M. Barnes separated the crude oil into at least two principal constituents, namely anacardic acid and cardol, which is a dihydric phenol. Wood treated with 5 per cent. cardol was readily attacked by the termites, however, whereas that treated with 1 per cent. anacardic acid was repellent.

WOLCOTT (G. N.). **Phenol as a Termite Repellent.**—*Science* 101 no. 2626 p. 444, 2 refs. Lancaster, Pa., 1945.

In tests in Porto Rico on the protection of susceptible woods from attack by *Kalotermes* (*Cryptotermes*) *brevis*, Wlk. [cf. preceding abstract] for which initial toxicity is of little importance as compared with permanence of repellency, samples submerged for ten minutes in solutions of 2, 5 and 10 per cent. phenol were attacked in 2, 3 and 4 days, respectively, whereas those treated with 2 per cent. fluorene, phenanthrene, fluoranthene and pyrene were protected for

73, 87, 360 and 195 days. Solutions of pentabromophenol, pentachlorophenol and hexachlorophenol were very effective, protecting the wood throughout the tests at concentrations of 1, 2 and 1 per cent., respectively. Solutions containing 1 and 0.5 per cent. pentachlorophenol did so for 337 and 273 days, but the other compounds had no lasting effect at 0.5 per cent. Copper pentachlorophenate was much more repellent than the parent compound, 0.01 and 0.02 per cent. solutions protecting the wood for 27 and 42 days and a 0.05 per cent. solution throughout the period of observation. Other metals have shown a repellent effect [*cf.* *R.A.E.*, A 32 29], and the possibility of obtaining even more effective repellents by combining metals with organic compounds is suggested.

PRILL (E. A.), HARTZELL (A.) & ARTHUR (J. M.). **Insecticidal Activity of some Alkoxy Analogs of DDT.**—*Science* 101 no. 2627 pp. 464-465, 7 refs. Lancaster, Pa., 1945.

The tests described were carried out on mosquito larvae and, by the Peet-Grady method, on house-flies (*Musca domestica*, L.). The results, which are noticed in more detail elsewhere [*R.A.E.*, B 33 119], indicated that 2, 2-bis (parachlorophenol)-1, 1, 1-trichlorethane (DDT) and its ethoxy analogue (2, 2-di-paraphenetyl-1, 1, 1-trichlorethane) were comparable in toxicity to both, and that the methoxy analogue (2, 2-di-para-anisyl-1, 1, 1-trichlorethane) was equally toxic to the mosquito larvae, but somewhat less toxic to the flies, though it gave a much higher knockdown than did the other two compounds. The *n*-propoxy analogue showed much less toxicity and the *n*-butoxy analogue practically none.

Preliminary feeding tests on rats indicated that the ethoxy analogue may be less toxic than DDT to the higher animals.

[GILYAROV (M. S.) & PRAVDIN (F. N.).] Гиляров (М. С.) и Правдин (Ф. Н.). **The Ecology of Kok-saghyz Pollination.** [*In Russian.*]—*Bull. Acad. Sci. U.R.S.S. Sci. biol.* 1943 no. 6 pp. 343-360, 3 graphs, 12 refs. Moscow, 1943. (With a Summary in English.) [*Recd.* 1945.]

Observations showed that pollination of *Taraxacum kok-saghyz* growing wild in south-eastern Kazakstan is mainly effected by solitary bees of the genus *Halictus* and to a less extent by bumble bees (*Bombus*), ants (*Formica*) and flies. In fields in which *T. kok-saghyz* was cultivated in the Province of Moscow in 1938, honey bees and *Halictus* spp. were the chief pollinating agents, flies being next in importance; bumble bees were fairly common. Bees were the predominant pollinating insects at temperatures above 17°C. [62.6°F.] and flies at lower temperatures.

No artificial pollination of *T. kok-saghyz* grown in hot-houses in winter and spring for selective breeding was required if bee-hives were kept there.

HARRIS (W. V.). **The Army Worm.**—*E. Afr. agric. J.* 10 no. 1 pp. 2-6, 2 figs., 5 refs. Nairobi, 1944.

In Tanganyika and Kenya, sudden outbreaks of the armyworm, *Laphygma exempta*, Wlk., occur in December-March; they last only 7-10 days in any particular area, so that there is little opportunity for organising control, and a second outbreak in the same season is unlikely. All stages of this moth are briefly described. The eggs are deposited in irregular masses, usually on suitable food-plants, such as *Cynodon* sp. or seedling grain, and the larvae move from

leaf to leaf in search of food while young and migrate in armies in search of fresh food as they grow larger. They are destroyed by birds, ants, predacious wasps and Ichneumonid, Chalcidoid and Tachinid parasites. From eggs collected during an outbreak at Morogoro in February 1944, two generations were reared in 50 days at an average daily temperature of 79°F., the larval stages lasting 10 and 12 days, respectively, and the pupal stages 9 and 11, but there was no evidence of a second generation in the field. The causes of outbreaks of *L. exemplis* are discussed in the light of the theories of Hattingh [R.A.E., A 30 609] and Faure [32 285].

Infestations should be destroyed in the early stages ; when there is a rising temperature with enough rain to produce a flush of young grass, damp places with patches of fine-leaved grass should be inspected for larvae and sprayed with 5 oz. sodium arsenite per 4 gals. water if any are present. Cultivated land can be protected by making a furrow, 18 ins. deep and with vertical sides, across the line of advance of the larvae, and spraying with sodium arsenite or pulling a log along the bottom when many larvae are in it. Poison baits are not usually satisfactory, but the author has protected young maize and sorghum by dusting with 20 lb. per acre of barium fluosilicate, which is not poisonous to stock at this rate of application.

ANANDA RAU (S.). **Report of the Entomologist 1943-44.**—*Rep. Tea Sci. Sect. U.P.A.S.I. 1943-44* pp. 5-7. Madras, 1944.

During observations on the effect of high and low pruning on the incidence of *Helopeltis* on tea in south Travancore, high pruning was followed in each of the three years of a pruning cycle by greater yields [cf. R.A.E., A 32 433, etc.], and in 1943-44 it was found that the total yield after skiffing from high-pruned bushes during the year following this cycle was 9.4 per cent. more than that from low-pruned ones, although the difference was not statistically significant. In November, infestation by *Helopeltis* became general over an area of tea at the Experiment Station, where it had previously been scarce. All stages were present, and activity increased until the middle of January, but the Capsid had disappeared by mid-March. The attack was light and caused no appreciable damage ; the flushing of the bushes was not affected. *Dendrothrips bispinosus*, Bagn., occurred again on the estate in the Nilgiri Hills on which it was reported during the previous year [loc. cit.], but did not become so abundant. It was most numerous in March-April, and decreased considerably after the break of the monsoon in mid-May. It is probably always present on tea, but becomes injurious only when conditions are favourable to it and unfavourable to tea. A long period of bright, dry, hot weather is thought to favour the thrips. It is believed that the young growth on bushes that have been pruned is particularly attractive to it, and light tipping is therefore recommended ; instances are reported in which bushes that were attacked soon after hard tipping were damaged so severely that it was eight months before they were ready for plucking. Other pests of tea recorded during the year were *Paratetranychus* (*Tetranychus*) *bioculatus*, W.-M., *Eriophyes carinatus*, Green, *Agromyza* (*Melanagromyza*) sp., and a Coccid, probably *Pinaspis* (*Hemichionaspis*) *theae*, Mask.

Pests of shade trees for tea included a borer, probably the Pyralid, *Terastia meticulosalis*, Gn., that attacked seedlings of dadap [*Erythrina*] in the Anamallais but not plants raised from cut stumps. Seeds of *Albizia* that were set out in baskets to germinate and failed to do so were found to have been attacked by *Collembola*, but it could not be determined whether they had fed on sound seeds or only on seeds that had begun to decay.

*Icerya purchasi*, Mask., a pest of *Citrus*, is stated to have been present in the neighbourhood of the Station for some time.

PROCTER (C. H.). **A Virus Disease of Henbane (*Hyoscyamus niger* L.) in New Zealand.**—*N.Z.J. Sci. Tech.* **26** (A) no. 2 pp. 83-87, 7 figs., 4 refs. Wellington, N.Z., 1944.

The cultivation of henbane (*Hyoscyamus niger*) in New Zealand was begun experimentally in 1942, and it was observed in 1943 that 10-20 per cent. of the one-year-old plants were suffering from root-rot and that their foliage showed symptoms of virus infection. By rubbing juice from infected plants on the leaves of healthy ones, the virus was easily transmitted to *H. niger* and tobacco (*Nicotiana tabacum*), from tobacco to tobacco, *H. niger* and six other species of solanaceous plants, and from four of the latter to tobacco. The symptoms observed in *H. niger* and in some of the experimental hosts are described. In experiments on the possibility of transmission by *Myzus persicae*, Sulz., the Aphids were allowed to feed for a week on infected *H. niger* plants and were then caged for a further week on six healthy plants of *H. niger* and four of tobacco. All the former and two of the latter became infected. The characteristics of the virus are described; it could not be identified with *Hyoscyamus* virus II, *Hyoscyamus* virus III or *Solanum* virus II, but since there were close resemblances, the author considers it undesirable to record it as new until its relationships have been further investigated.

GIVEN (B. B.). **A Record of *Paniscus* sp. attacking *Pieris rapae* Larvae in New Zealand.**—*N.Z.J. Sci. Tech.* **26** (A) no. 2 pp. 94-96, 4 figs., 1 ref. Wellington, N.Z., 1944.

In January 1942, one egg of an Ichneumonid of the genus *Paniscus* was found on each of four larvae of *Pieris rapae*, L., in a small bed of cabbage at Nelson, New Zealand. All the *Pieris* larvae had previously been parasitised by the Braconid, *Apanteles glomeratus*, L., and although larvae hatched from the three *Paniscus* eggs left undisturbed, none reached the second instar owing to the emergence of the *Apanteles* larvae and the death of the hosts. No further attack by *Paniscus* was observed.

DUFF (C. E.). **Termite Resistance Test on the Copperbelt of Northern Rhodesia.**—*Emp. For. J.* **23** no. 2 pp. 160-162. London, 1944.

The experiment in Northern Rhodesia in which three imported coniferous timbers and 26 indigenous woods, untreated or impregnated with chemicals, are being tested for resistance to native termites [*cf. R.A.E.*, A **23** 723], of which at least six species were involved, has been continued for 11 years. The methods adopted are recapitulated, and the results to date briefly discussed.

The following is based on the author's conclusions. Untreated heartwood of *Baikiaea plurijuga*, *Fromosia angolensis*, *Amblygonocarpus obtusangulus*, *Entandrophragma caudatum*, *Pterocarpus angolensis*, *Albizia antunesi* and *Erythrophloeum africanum* showed little injury at the end of the experiment, and that of species of *Peltophorum*, *Afzelia*, *Marquesia* and *Monotes* and even of *Brachystegia utilis* was fairly resistant for five years. Impregnation with 3 per cent. sodium arsenite or about 1 per cent. arsenious oxide, which were equally effective, gave good results, and since the arsenic took six years to leach out of the wood under the local conditions of rainfall (50 ins. per year), this treatment will prolong the durability of the common native woods for six years. Impregnation with 4.5 per cent. zinc chloride was less than one-third as effective, and its effects wore off in two years. The results with copper sulphate were inconclusive, but did not appear promising.

HELY (P. C.). **The White Louse Scale** (*Prontaspis citri*). **A Pest of coastal Citrus Trees.**—*Agric. Gaz. N.S.W.* 55 pt. 7 pp. 283–285, 1 fig. Sydney, 1944.

*Unaspis* (*Prontaspis*) *citri*, Comst., infests *Citrus* throughout the coastal districts of New South Wales, but is rarely seen inland. It usually occurs on the trunk and main branches, weakening the latter, which may become subject to attack by wood borers, and preventing normal expansion of the bark, so that it cracks when the infestation has subsided and normal growth is resumed. When infestation is severe, it may spread to the small twigs, leaves and fruit, causing discoloration and premature falling of the leaves and reduced size and a pitted appearance of the fruit. Twigs and branches are occasionally killed, particularly if they have already been weakened by *Lepidosaphes beckii*, Newm., though this is unusual. The development of *Unaspis* is accelerated by warm dry weather in late summer and autumn, and under these conditions the injury caused is accentuated by the lowered moisture content of the soil.

The life-history is briefly described [*cf. R.A.E.*, A 23 633]; there are several overlapping generations in the year, and the period between the settling of the crawlers and the production of young is about  $2\frac{1}{2}$ –3 months in summer and longer at lower temperatures. The young hatch soon after the eggs are laid and crawl from beneath the parent scale. They are produced over considerable periods; the average number per female in a series of observations was 85, and one female produced 169 in the course of 146 days. They emerge throughout the year, but mostly during late spring, summer and autumn, and infestation usually reaches a peak in March, April and May. The scale seldom occurs on plants other than *Citrus* and prefers mature trees. It is probably introduced into uninfested orchards by birds and insects and by the movement of infested plants and spread through the orchards by wind or by picking or pruning operations.

The most important natural enemy of *U. citri* is an unidentified Tineid of the genus *Stathmopoda*, the larva of which feeds on it under a mass of fine white webbing. The Coccid is parasitised by species of *Aspidiotiphagus*, *Coccophagus* and *Aphelinus* and, under humid conditions, by entomogenous fungi, particularly *Sphaerostilbe* sp. It can be controlled by fumigation [22 477] or by a spray of lime-sulphur (1.5–1.6 per cent. calcium polysulphide), with the addition of  $\frac{1}{2}$  lb. casein-lime spreader per 40 gals., applied at any time of the year [*cf.* 30 231]. This spray hinders the formation of the scale coverings and prevents the emergence from them of crawlers and adult males, so that reproduction is not effective and the population gradually dies out. Oil sprays often give poor results as the scale occurs chiefly on the older bark, which absorbs much of the available oil.

JARVIS (H.). **Pineapple Scale.**—*Qd agric. J.* 59 pt. 1 pp. 26–29, 2 figs. Brisbane, 1944.

A localised outbreak of *Diaspis bromeliae*, Kerner, recently occurred in Queensland, where this Coccid has been recorded only from pineapple. All the infested plants were four or more years old and showed signs of declining vigour, even in areas where the scale population was negligible; the severity of the attack indicated that the pest had been present in the district for some years, but natural dispersion appeared to be very slow. There are several generations in the year, and development lasts approximately two months during the warmer part of it. Infestation of the leaves, stems and fruit results in small fruits, weak off-shoots and stunted growth.

Although well-known in most countries where pineapple is grown extensively, *D. bromeliae* is apparently seldom an important factor limiting production, probably because planting material is usually drawn from the off-shoots of plants less than two years old, which are unlikely to harbour it unless they were infested when planted out, and with short-term rotations, the cropping period

allows insufficient time for the populations to reach troublesome proportions. Spraying with white-oil emulsions in summer kills the Coccids that are reached, but is ineffective in the field because many shelter in protected parts of the plant. The best method of preventing damage is to use only uninfested plant material, preferably from two-year-old stands that have just completed bearing their first crop of fruit in areas in which the scale has not been seen. If, in spite of this, infestation appears on a plantation, it is usually confined to a small area for some time and may be eradicated by digging up and burning all infested plants and spraying plants in a marginal strip round the infested area with white-oil emulsion (1 : 40).

CARTER (Walter). **Some etiological Aspects of Mealybug Wilt.**—*Phytopathology* **35** no. 5 pp. 305–315, 5 figs., 7 refs. Lancaster, Pa., 1945. **The Influence of Plant Nutrition on Susceptibility of Pineapple Plants to Mealybug Wilt.**—*T.c.* pp. 316–323, 1 ref.

In these two papers, the author describes investigations on various aspects of pineapple wilt, caused by the feeding of mealybugs [*Pseudococcus brevipes*, Ckll.] in Hawaii [cf. *R.A.E.*, A **25** 743, etc.]. In the first, he classifies the developing symptoms into four stages, with a fifth stage indicating recovery. Experiments showed that the period between infestation by the mealybugs and the appearance of symptoms was in most cases 58–78 days for plants five months old and 82–181 days or more for those 9½ months old. Symptoms appeared more rapidly in plants grown at high nitrogen levels or in soil sterilised with chloropicrin than in others. If the mealybugs are removed from a wilted plant, the affected leaves usually remain on it until senescent without loss of symptoms, but the new centre leaves grow normally, and such plants are referred to as having recovered. Plants in which the symptoms had not progressed beyond reddening of the leaves frequently lost all symptoms when kept free of mealybugs. Wilt is associated with the death of roots, and recovery with the production of new roots. Nitrogen-fertilisation increased recovery among plants that were infested when three months old, but reduced it among those that were infested when several months older and so could not produce so high a proportion of new roots to replace the dead ones. Similarly, plants that had been infested only once recovered to a much greater extent than those that had been infested three times at monthly intervals, presumably because repeated loss of roots by the latter reduced their ability to produce new ones. Recovery did not affect susceptibility to subsequent reinfestation. Populations of mealybugs that were insufficient to cause wilt on the plants on which they occurred naturally caused it when united on a few plants, so that it is dangerous to pile the crowns of the harvested fruits at the ends of the rows, as used to be the practice. On plants five months old, though not on those 9½ months old, the incidence of wilt was greater in those on a southern exposure. Wilted plants usually occur in localised areas in a field, though not necessarily in the same areas on successive occasions, and it is thought that localised susceptibility may be a result of microbial activity in the soil. Plants grown on virgin soil are less susceptible to wilt than those grown on land that has already been under pineapple. When infested planting material is set in a properly prepared field, most of the mealybugs usually disappear in a short time, but in experiments this did not affect the percentage of plants that developed wilt following subsequent infestation. The experimental infestations were made by means of pieces of the rind of infested fruits, and no differences were observed in the ability of colonies from different fruits to induce wilt.

It is recorded in the second paper that susceptibility to wilt was not affected by differences in fertiliser treatment, though high nitrogen applications appeared to reduce it in one test. Adverse growing conditions increased the susceptibility of plants that had recovered to wilt following reinfestation.

**Notes and Exhibitions** [presented at meetings of the Hawaiian Entomological Society in 1943].—*Proc. Hawaii. ent. Soc.* **12** no. 1 pp. 1-29, 5 refs. Honolulu, 1944.

Cocoons attached to the dried silks of maize in a field on Oahu in February 1943 were found to be those of the Dryinid, *Haplogonatopus vitiensis*, Perkins, which had probably developed in *Peregrinus maidis*, Ashm.; adults that emerged from the cocoons readily parasitised examples of this Delphacid confined with them, and normal adults were reared from this material. The Braconid, *Apanteles marginiventris*, Cress., which was introduced into Hawaii for the control of *Laphygma exempta*, Wlk. [*R.A.E.*, A **32** 246], was found to have spread for distances of 20-25 miles from the points of liberation on Kauai. When the Tachinid, *Blondelia (Eucelatoria) armigera*, Coq., was reared on larvae of *L. exempta* in the laboratory [cf. **31** 474], there appeared to be no correlation between the sex ratio of the adults and the number of maggots per host larva, and 48.8 per cent. of the flies reared were males. Adults were liberated on Maui in February and March 1943, and one was recovered in June.

Parasites bred from the tomato pin worm, *Keiferia lycopersicella*, Busck, were identified as *Parahormius (Hormius) pallidipes*, Ashm., and *Apanteles dignus*, Mues., both new records for Hawaii, and *Chelonus blackburni*, Cam. The mite, *Phyllocoptes destructor*, Keifer, was found on tomato plants on Oahu and Maui in 1942, causing severe injury in some cases, and also occurred on the weed, *Solanum nodiflorum*, on Oahu. Tomato plants on this island were also infested by *Tarsonemus (Hemitarsonemus) latus*, Banks, and some were killed by the ant, *Solenopsis geminata rufa*, Jerd., which fed on the stems, chiefly underground. Onion was attacked by *Acrolepia assectella*, Zell., and carrot by *Aphis ferrugineastriata*, Essig, and heavy populations of *Phenacoccus gossypii*, Tns. & Ckll., were present on lima bean and egg-plant [*Solanum melongena*]. Large numbers of adults of *Maruca testulalis*, Geyer, one of *Cosmolyce (Lampides) boetica*, L., and two of *Amorbia emigratella*, Busck, emerged from flowers of *Gliricidia sepium* collected in February and early March, and it is considered possible that increased populations of *Maruca* due to the presence of this plant might have a noticeable effect on the infestation of string beans and lima bean.

*Lema trilineata californica*, Schaeffer, has been found breeding on a number of wild food-plants, including the solanaceous weed, *Nicandra physaloides*, as well as on potato; it was also found on tobacco. The Syrphids, *Eumerus marginatus*, Grimshaw, and *E. aurifrons*, Wied., were reared from roots of cassava (*Manihot utilissima*) from Oahu; infestation had apparently begun in a diseased portion of the root and spread to the sound part, causing this to rot. Colonies of *Tecnomymex detorqueus*, Wlk. (*albipes*, F. Sm.) were found to be prevalent in tightly curled leaves of litchie (*Litchi chinensis*) in Hawaii in October; in each case the occupied leaves were heavily infested by the mite, *Eriophyes litchii*, Keifer, which had caused the deformation.

*Taeniothrips xanthius*, Williams, was found to be breeding freely on the leaves of *Asystasia gangetica*, growing under benches of a greenhouse in Manoa. Orchids, particularly *Cypripedium*, in the house were seriously injured by this thrips in spite of the use of contact sprays, and the persistence of injury was evidently due to the presence of an alternative food-plant. The extremely narrow range of food-plants of this thrips indicates that dissemination from one orchid house to another occurs when orchids are transferred, but it probably depends on *Asystasia* as well as orchids for survival within a house, and keeping them free from *Asystasia* is evidently necessary for control.

New food-plant records include *Momordica balsamina* for *Ceratitis capitata*, Wied., chili peppers [*Capsicum*] for *Emolus (Thecla) echion*, L., lettuce seedlings for *Plusia (Autographa) brassicae*, Ril., and celery (leaves and petioles) for *Coccus viridis*, Green.

FULLAWAY (D. T.). **Description of a new Mymarid Egg Parasite collected at Los Mochis, Sinaloa, Mexico.**—*Proc. Hawaii. ent. Soc.* **12** no. 1 p. 57. Honolulu, 1944.

Descriptions are given of both sexes of *Anagrus yawi*, sp. n., reared from eggs of the Capsid, *Pycnoderes quadrimaculatus*, Guér., in Sinaloa, Mexico. This Mymarid has been introduced into Hawaii [where its host is a pest of various vegetables] and has become established.

HOLDAWAY (F. G.). **Insects of Vegetable Crops in Hawaii today.**—*Proc. Hawaii. ent. Soc.* **12** no. 1 pp. 59–80, 37 refs. Honolulu, 1944.

The author discusses changes that have taken place in agriculture in Hawaii since the beginning of the century, the insects injurious to vegetables that have been introduced into the Territory and the changes in importance of some of those already there, and reviews the present position. He gives a table in which the insect and other pests of some 30 vegetable crops grown there are arranged in four categories of importance, followed by notes on the control of the more injurious ones.

LOOK (W. C.) & MCAFEE (E. L.). **Some first Records of Aphids in Hawaii.**—*Proc. Hawaii. ent. Soc.* **12** no. 1 pp. 95–98, 8 refs. Honolulu, 1944.  
**New Host Records of Aphids in Hawaii.**—*T.c.* pp. 99–112, 13 refs.

Aphids recorded for the first time or on new food-plants during the past few years in Hawaii include *Aphis gossypii*, Glov., on papaya, sweet potato, tomato, passion fruit (*Passiflora edulis*), beans (*Phaseolus vulgaris*), *Cattleya* sp., *Crotalaria mucronata* and *Erechtites valerianaefolia*; *A. maidis*, Fitch, on asparagus, papaya, summer squash (*Cucurbita pepo*) and tomato; *A. medicaginis*, Koch, on asparagus, papaya, sweet potato, potato, tomato and *E. valerianaefolia*; *A. middletoni*, Thos., on papaya; *A. rumicis*, L., on lima bean, *E. valerianaefolia* and *Nothopanax guilfoylei*; *Brachycolus heraclei*, Takah., on celery; *Cavariella capreae*, F., on carrot; *Idiopterus (Micromyzus) formosanus*, Takah., on onions and chives; *Macrosiphum solanifolii*, Ashm., on papaya, sweet potato, potato, lettuce, tomato, edible-podded pea (*Pisum sativum macrocarpon*) and egg-plant (*Solanum melongena*); *Myzus circumflexus*, Buckt., on papaya and rose; *M. persicae*, Sulz., on garden beet, Chinese cabbage (*Brassica pekinensis*), sweet potato, lettuce, tomato, bean, daikon radish (*Raphanus sativus longipinnatus*), *Arctium lappa* and *Crotalaria mucronata*; *Pentalonia nigronervosa*, Coq., on taro (*Colocasia esculenta*); *Rhopalosiphum pseudobrassicae*, Davis, on broccoli, Chinese cabbage and daikon radish; and *Toxoptera aurantii*, Boy., on *Calophyllum inophyllum* and mango flowers.

Alates of some of these Aphids are recorded on additional plants, and those of *A. sacchari*, Zhnt., on sweet potato, potato, tomato, bean, and *Sonchus oleraceus*, those of *R. nymphaeae*, L. (which breeds on *Colocasia esculenta*) on bean and potato, and those of *Vesiculaphis caricis*, Fullaway, on tomato. Apteræ of *I. formosanus* were found on beans near infested chives, but it was probably not breeding on them.

SAKIMURA (K.) & KRAUSS (N. L. H.). **Thrips from Maui and Molokai.**—*Proc. Hawaii. ent. Soc.* **12** no. 1 pp. 113–122, 20 refs. Honolulu, 1944.  
SAKIMURA (K.) & NISHIDA (T.). **Thrips from Kauai.**—*T.c.* pp. 123–131, 13 refs.

These papers comprise records of various thrips from the three islands followed by lists of the species known to occur on them. *Hercothrips fasciatus*, Perg., which had not previously been found in the Hawaiian Islands, was numerous in June 1943 on the leaves, buds and flowers of several plants of prickly poppy (*Argemone alba* var. *glauca*) growing on the bank of a dry stream

bed near Kaunakakai, Molokai. It had probably been introduced from California on plant material, possibly oranges. It was not found in neighbouring areas in June or during a more extensive survey of known and potential food-plants throughout the island in October, and the original infestation apparently died out during the hot, dry summer.

**Bekämpfungsmittel und Bekämpfungsverfahren.** [Means and Methods of Control.]  
—*Verh. 7. int. Kongr. Ent., Berlin 1938* 4 pp. 2927–3079. Weimar, 1939.

The papers in this section include: **Natürliches Kryolith ("Cryocid") als Bekämpfungsmittel** [Natural Cryolite as a Means of Control], pp. 2961–2965, 6 refs., in which P. BOVIEN briefly reviews the results of experiments in Denmark with cryolite in dusts and sprays [cf. *R.A.E.*, A 24 440; 25 766] and in cutworm baits [24 55]; **Die Beziehungen zwischen der Wirkung von Spritzmitteln und dem Bau des Tracheensystems der Insekten** [The Relation between the Effect of Sprays and the Structure of the Tracheal System of Insects], pp. 2983–2992, 9 refs., by H. GÄBLER [cf. 27 579]; **Die Bekämpfung der Argentinischen Schwarmheuschrecken und neue Studien zur Verbesserung der Vernichtungsmethoden** [The Control of the Argentine Swarming Locusts and new Investigations on the Improvement of Methods of destroying them], pp. 3004–3012, 1 pl., by P. KÖHLER [cf. 25 116; 28 215]; **The physicochemical Factors affecting Spray Deposition and Spray Retention**, pp. 3013–3019, 1 graph, 7 refs., by H. MARTIN [cf. 26 370, etc.]; **The biological and chemical Tests of Efficiency of gaseous Insecticides**, pp. 3029–3039, 1 pl., 7 graphs, by G. PETERS [27 111]; and **Chemisch-biologische Grundlagen der Unterdruck-Schädlingsbekämpfung** [The chemico-biological Bases of Vacuum Fumigation], pp. 3040–3046, 1 pl., 5 figs., by G. PETERS [cf. 27 201].

In **Action antiparasitaire universelle du tabacol et actions (a) cicatrisante, (b) trophique et (c) stimulante des grains du tabacol**, pp. 2929–2937, 3 pls., N. A. BARBIERI gives an account of experiments carried out in Italy in 1937 and 1938, in which a 2 per cent. solution of tabacol [cf. 21 630] in water proved highly effective as an insecticide and fungicide, and stimulated the growth of plants when injected into the soil against worms and the germination of seeds soaked in it for 3–6 hours. The solution can be applied as a spray or by means of a cotton-wool pad or brush, according to the purpose for which it is used. The mechanism of its action is discussed.

In **Erfahrungen über das Fangen von schädlichen Insekten mit Hilfe des Manningerschen Apparates, besonders in bezug auf das Schonen der nützlichen Insekten** [Experiments on catching injurious Insects with Manninger's Apparatus, with special Reference to the Preservation of beneficial Insects], pp. 2938–2940, C. BLATTNÝ states that this horse-drawn apparatus for collecting insect pests has proved effective in tests and field practice in Czechoslovakia. It consists essentially of two sacks stretched on rectangular frames, with a car-wheel between them. Large numbers of *Sitona* (*Sitones*) spp. and *Lygus* sp. on lucerne, *Meligethes aeneus*, F., on rape, and Aphids on various crops were caught in the sacks by repeated sweepings without injury to the plants. Various modifications of the apparatus have been tested and since beneficial insects, mostly Coccinellids, were also caught when lucerne and other crops were swept, a sifter was evolved by means of which these are separated from the pests and released. In the main, the sifter consists of two tubs fitted one above the other; the upper tub has a bottom of tin perforated with holes small enough to retain adults of *Coccinella septempunctata*, L., but not *Sitona* or *Lygus*, or of wire netting to separate Coccinellids from Aphids. Since the Aphids tend to form a sticky mass that clogs the sieve, twigs are placed in the tub; the Coccinellids climb on to these and are then transferred to and separated in another tub. If the presence of Coccinellids is no longer desirable,

those collected can be liberated on other crops, on which they would be of more use.

In **Universal ovicidal Action of special Mineral Oil Washes as a Winter Wash for deciduous Fruit Trees**, pp. 2941-2960, 3 graphs, 1 map, 2 pls., 13 refs., P. A. BLIJNDORP states that as the tar-distillate spray usually applied to fruit trees in Holland and other countries in north-western Europe in January or February does not control the eggs of Capsids or *Paratetranychus pilosus*, C. & F., it is often followed in March or early April by a spray of mineral oil. It would be more economical to apply a single combined spray, but a mixture of tar oil and mineral oil, though effective, has disadvantages. Experiments were therefore carried out in Holland in 1937 and 1938 on the effect of a combined spray of mineral oil and 3, 5-dinitro-o-cresol (numbered with CH<sub>3</sub> as 1). In dipping experiments in the laboratory, emulsions of mineral oil containing small amounts of dinitro-cresol were shown to be effective against eggs of *Aphis pomi*, Deg., *Operophtera* (*Cheimatobia*) *brumata*, L., and *Gastroides viridula*, Deg., though the oil emulsions alone were not, and in field tests, the combined spray effectively controlled *Aphis pomi* and *Psylla mali*, Schm., on apple, *Paratetranychus pilosus* on apple and stone fruits, and *Lygus pabulinus*, L., on currants.

In **Penetration of Spray Liquids into Plant Tissue**, pp. 2966-2982, 3 graphs, 2 pls., 7 refs., W. EBELING discusses the results of experiments carried out in connection with the control of *Aonidiella aurantii*, Mask., on *Citrus* in California. The following is based on his summary. The fact that scales draw oil from the plant surface about their bodies suggests the desirability of retarding the penetration of the oil into the plant tissue. This can be done by adding a slightly polar solute to the non-polar oil; in experiments the order of decreasing effectiveness of four solutes in retarding the penetration of oil into the waxy cuticle of *Citrus* leaves was triethanolamine oleate, glyceryl mono-oleate, glycol mono-oleate and glyceryl oleate; the numbers of hydroxyl (polar) radicals in these substances are 3, 2, 1, and none, respectively. The penetration of a liquid into a capillary tube decreases with surface tension if the contact angle of the liquid in the tube is zero or nearly so, but increases with decrease in surface tension if the contact angle is high. It follows that liquids of which the surface tension can readily be reduced, such as aqueous solutions, may by a reduction in surface tension have their rate of penetration into the bark of trees reduced, with a simultaneous increase in their rate of penetration under the bodies and into the spiracles of scale insects, or into the mat of waxy threads covering colonies of the woolly apple aphid [*Eriosoma lanigerum*, Hsm.]. The solutes that reduce the rate of penetration of spray oils into waxy cuticles do not reduce the rate of penetration of these oils into porous solids, because they do not affect the factors (surface tension, contact angle and viscosity) that determine the rate and distance of flow of the oil into capillary tubes.

In **Sinnesphysiologie und Schädlingsbekämpfung** [Sense Physiology and Pest Control], pp. 2993-3003, 23 refs., B. GÖTZ discusses from the literature and his own observations in Germany the extent to which the senses of smell, taste, sight and touch influence the movements of insects. The results as regards Lepidopterous larvae have already been noticed [27 7]. He concludes that in adult insects the keenest sense is that of smell, and gives examples of the use against them of baits and repellents. The males of some moths are attracted by the scent of the females, and this fact can be made use of for control or the discovery of new infestations. The sense of taste is less developed, but sweetened bait-sprays are effective against fruit-flies and some other Diptera and moths. In a few cases, insects appear to be guided to some extent by sight. He considers that further study of the physiology of the senses of insect pests would be of value in improving control measures.

In **The ovicidal Properties of Tar and Petroleum Oils**, pp. 3020-3021, H. MARTIN states that investigations of the toxicity of different types of hydrocarbon oils to the eggs of orchard pests against which they are used in dormant or delayed

dormant sprays in Britain have led to the following conclusions. Ovicidal efficiency increases with molecular weight as judged by such physical characteristics as boiling range and viscosity. The chemical character of the oil is associated with toxicity in that toxicity to eggs of Aphids and Psyllids increases with the content of aromatic hydrocarbons. Aromatic hydrocarbons are not toxic to eggs of *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.), and are less toxic than saturated and unsaturated hydrocarbons to eggs of Geometrids and Capsids. The presence of phenolic compounds (tar acids) reduces the toxicity of the hydrocarbons to eggs of Geometrids and Capsids. No evidence has been found that the character of the emulsifying agent used in the sprays influences their toxicity.

In **Indirect Effects of Spray Practice on Pest Populations**, pp. 3022-3028, 2 refs., A. J. NICHOLSON discusses the problem of whether an initially effective spray will continue to control a pest if applied in the same area for a number of years. He suggests that the great reduction in the numbers of the pest when the spray is first applied disturbs the natural balance between it and its environment and that if spraying is continued as a routine, a new state of balance will ultimately be attained, the spray programme becoming one of the factors with which the pest population is balanced. The density at which the new balance is reached, however, is not necessarily lower than before, and it may even be higher. This may occur even though the spray does not kill natural enemies or lead to the development of a strain of the pest that is resistant to it. He briefly reviews the question of the balance of insect populations [cf. 21 369; 24 6], and illustrates his theory that the abundance of a pest is really determined by competition and not by the favourableness or otherwise of the environment by an analysis of three hypothetical situations, in which natural means of control are supplemented by artificial measures. He concludes that the routine application of an artificial method of control mainly destroys only the surplus individuals of the pest, and that competition always tends to counteract its direct effects and may even reverse them. Estimates of the immediate results of a spray in field experiments should therefore be supplemented by detailed ecological studies to discover the characteristics and influence of competition in the special problem under examination.

In the course of the discussion that followed, H. Martin pointed out that the cases analysed by the speaker concerned balanced populations and that the need for the application of an insecticide usually arises when the natural balance has already been disturbed by other factors so that the pest is increasing in numbers.

In **Nebelspritzung, eine erfolgreiche Methode der Feldbauschädlingsbekämpfung in Mitteleuropa** [Atomised Spraying, a successful Method of controlling agricultural Pests in Central Europe], pp. 3047-3058, 5 pls., 14 refs., W. E. RIPPER points out the advantages of atomised sprays over spraying or dusting by the ordinary methods [cf. 21 473] and describes an apparatus for applying them that was built on the same principle as those already noticed [cf. 21 474; 23 34], but had nozzles that produced the mist under considerably lower air-pressure, so that the amount of fluid ejected per minute was approximately a quarter of that released by an ordinary nozzle at higher pressure. The apparatus was mounted on a motor truck with a clearance of 3-4½ ft., and the nozzles were protected from wind by a fabric hood hanging over a frame that extended some 13 ft. behind, so that the mist was not blown away from the plants. The sprays used contained little or no oil, and owing to the better suspension of the particles fewer nozzles were necessary than in ordinary spraying and the total output of fluid was only one-fifth of that usually applied. In experiments in Austria in which a knapsack sprayer was used in 1937 and motor-driven machines in 1938, two fungicides and Paris green, calcium arsenate and lead arsenate were successfully applied in atomised sprays to lucerne, beans and peas. The residues were evenly distributed over both horizontal

and vertical parts of the plants, and the droplets did not coalesce and run off. The amount of residue on the upper half of the plants was considerably greater than on plants sprayed in the ordinary way, though no wetting or adhesive agents were used and, the rate of application was halved. Atomised sprays containing contact poisons were effective against jumping insects, complete mortality of flea-beetles on beet being given by a mixture of highly refined mineral oil and 5-10 per cent. derris (7 per cent. rotenone), or a suspension in water of 5 per cent. derris and 1 per cent. summer oil. In the case of insects that do not jump or fly when disturbed, such as Aphids on beet or peas, good results were obtained only when the atomised spray of derris and oil was applied from a knapsack; in experiments on a large scale mortality did not exceed 75 per cent. To test their possibilities against flies infesting cereals, atomised sprays were applied against Trypetids on Compositae during their oviposition period; and good results were given by pyrethrum extract in highly refined mineral oils, with or without the addition of water, or in water with the addition of sulphated alcohol as a wetting-agent. These insecticides are too expensive for practical purposes, however, and substitutes would have to be found.

In **Über neue Heissluftverfahren gegen Material-, Vorrats- und Gesundheits-schädlinge** [New Hot-air Treatments against Pests that infest Materials and Stored Products or are injurious to Health], pp. 3059-3064, E. WINKLER reviews the difficulties that have so far attended the hot-air treatment of buildings against household pests and those of stored products and constructional timbers, and states that two effective methods are now in use in Germany. The first, known there as the Thermodes hot-air process, was developed by Rennerfelt in Sweden. The heat is generated by a portable oil stove and regulated by means of thermostat controls, and the air is circulated under pressure by a compressor built into the apparatus. The rooms to be treated need not be airtight. It gives a very uniform distribution of heat and is not injurious to furniture. It is well suited for use against *Hylotrupes bajulus*, L., in roof timbers. Dwellings can be freed from bed-bugs [*Cimex lectularius*, L.] in 6-8 hours, and complete control has been obtained in practice of mites, cockroaches and other household pests. In laboratory tests, various pathogenic bacteria were destroyed within periods of 3-6 hours, and the development of moulds and fungi was prevented.

The second apparatus, known as the Deob-dryer, was originally intended for drying houses and has been adapted for use against *H. bajulus*. It consists of a portable coke stove that burns for 12-14 hours without attention. The gases are led off through special pipes, carbon monoxide is not released into the room, and circulation is effected by ventilation, windows in attics, etc., being opened during treatment. Heating is somewhat slower than in the case of the oil-burner, and the temperatures reached are shown by thermometers distributed about the room. Control of the larvae of *H. bajulus* is complete when the temperature in the interior of timber reaches 50-52°C. [122-125.6°F.], and this is obtained in a normal attic after heating for two or three days.

In **Tree Fumigation Investigation in Egypt**, pp. 3065-3079, 5 tables, M. S. EL ZOHEIRY states that *Citrus* trees have been fumigated with hydrocyanic acid gas for the control of *Chrysomphalus ficus*, Ashm., in Egypt since 1912, and that the treatment was made compulsory over all infested parts of the country in 1923. The pot method [cf. 23 691] was used exclusively until 1926, after which the Zyklon method [cf. 15 8] was tried but abandoned because it injured the trees. Between 1928 and 1934 calcium cyanide in the form of Cyanogas and Calcid, liquid HCN, and the Cyfate method were introduced. In the last-named, 1 part sodium cyanide is dissolved in 4 parts water and the solution added to 3 parts sodium bisulphate, and the pot-method dosage table is employed. Since the use of Cyanogas in 1930 resulted in injury to the trees in some localities and inadequate control in others, the author carried out experiments on over 25,000 trees between 1931 and 1937 to determine the causes of

the unsatisfactory results. He found that the effect of applying Cyanogas and Calcid according to the manufacturers' dosage tables and liquid HCN according to Palestine usage was not uniform, because the same dose was recommended for series of 5-7 trees of gradually increasing size. The volume of the last tree in each series was about double that of the first, and this resulted in injury to the smaller tree and insufficient mortality on the larger one. He therefore compiled new dosage tables for Cyanogas, Calcid and liquid HCN, which are included in the paper; 1 gm. sodium cyanide is equivalent to 0.9 gm. Calcid, 0.6 cc. liquid HCN, or 2.2 gm. Cyanogas.

The average percentage mortalities of the scale were 98.2 for Cyanogas, 98.6 for the Cyfate method, 99 each for the pot-method and liquid HCN, and 99.4 for Calcid. The minimum relative humidity required to generate the gas from Calcid or Cyanogas was about 30 per cent., but satisfactory mortality of the scale was never obtained when the relative humidity was below 41 per cent. The maximum safe temperature for fumigation by all methods was 88°F., and the maximum safe relative humidity 94 per cent. on heavy soils and 88 per cent. on sandy soils or orchards close to the Nile or large areas of water. Wind caused a 2 per cent. decrease in the rate of mortality even though the excess cloth was rolled and earth piled on it outside the tent. Under the conditions obtaining in Egypt, the Calcid method proved to be the cheapest, simplest and most effective. All orchards fumigated during the early months of the season become reinfested before the end of it, and observations showed that if less than 1 per cent. of the scales survive fumigation in August, September, October, November, December, January or February, the degrees of reinfestation six months later are 66, 18, 17, 10, 0, 0, and 2½ per cent., respectively. Injury to the leaves and fruits was caused when fumigation was carried out between 11.30 a.m. and 2.30 p.m., while the fruits were changing colour, or in October or November (especially in years of high Nile floods). It also occurred if the trees were watered just before or after treatment; if the tents were put on more than half an hour before fumigation, which caused a rise in temperature and sweating of the leaves; if normal dosages were applied to unhealthy trees or trees in which a single branch extended much beyond the others; if the fumigant was applied from the side of the tent facing the sun; and if trees were treated before bait-sprays of sodium fluosilicate and sugar applied against *Ceratitis capitata*, Wied., had completely dried on them. Branches that touch the ground are frequently scorched, especially when Cyanogas or the pot method is used, and some varieties and species of *Citrus* are more susceptible to injury than others.

SLADE (R.). **A new British Insecticide. The Gamma Isomer of Benzene Hexachloride.**—*Chem. Trade J.* 116 no. 3017 pp. 279-281. London, 1945. [From Hurter Memorial Lecture of 8th March, 1945.]

In several years' experiments at one of the English laboratories of Imperial Chemical Industries, begun in 1934, thousands of organic and other chemical compounds were tested as insecticides but did not show promise as substitutes for pyrethrum and derris because they were either less effective or were injurious to plants. In 1942, however, benzene hexachloride (1, 2, 3, 4, 5, 6-hexachlorocyclohexane), which, for brevity, was called 666, gave promising control of the turnip flea-beetle [*Phyllotreta nemorum*, L.]; the results of laboratory and small-scale field tests against a number of other insects were encouraging, but less consistent than was expected. In 1943, a finely divided powder of 666 and gypsum (1 : 4), standardised by biological tests and further diluted for application to crops, was used on an extensive scale for flea-beetle control in England, and was at least as effective as derris dusts had been. Meanwhile, a method was developed for separating the four known isomers of 666, and experiments with these showed that the  $\alpha$  and  $\beta$  isomers were relatively inactive against weevils,

whereas the  $\gamma$  isomer (gammexane), which forms 10-12 per cent. of the crude compound, was more toxic to them than any other substance tested.

Benzene hexachloride possesses considerable chemical stability; it is unaffected by exposure to light or hot water and can be crystallised from hot, concentrated nitric acid, and it will therefore be unaffected by continued exposure to the atmosphere. Although the molecule loses hydrogen chloride in the presence of alkalis such as lime-water or dry lime at 60°C. [140°F.] or ordinary temperature, it is not decomposed at either temperature by ground limestone or chalk, dry or in the presence of water, and is therefore stable in natural waters. The pure isomers are practically insoluble in water, soluble in organic solvents, almost inodorous and bitter to the taste. The material can be used as a powder or in solution in an organic solvent, such as methyl alcohol, xylene, carbon tetrachloride, perchlorethylene or decahydronaphthalene; solutions containing 5 per cent. or more gammexane can be diluted for use with kerosene or other suitable oils. Concentrated solutions that give stable emulsions suitable for field sprays on the addition of water can be prepared by the addition of an emulsifying agent such as a sulphonated castor oil (selected Turkey Red Oil). A powder prepared from crude 666 or from the solid product resulting from the removal of the  $\alpha$  isomer from this and rendered dispersible by incorporating an adequate amount of sulphite lye (Goulac), can also be used with water as diluent. Since gammexane is exceptionally stable at high temperatures, it can be applied as an aerosol by volatilisation from hot plates or other heating methods.

Preliminary laboratory tests showed that gammexane was highly toxic in baits for the African migratory locust [*Locusta migratoria migratorioides*, R. & F.], being lethal to the hoppers at the rate of one part 666 per 2,000 parts bran, and field tests in North Africa gave highly successful results. The same bait killed house crickets [*Gryllulus domesticus*, L.] on refuse heaps, and a dust effective against crickets has also been prepared. The product appeared to have considerable value as a soil insecticide against wireworms and was toxic to the grain weevil [*Calandra granaria*, L.] in dusts applied to give concentrations as low as one part gammexane per million parts wheat; no effect could be detected on flour made from the wheat. Other pests against which it showed high toxicity included larvae of cabbage butterflies [*Pieris* spp.] the winter moth [*Operophtera brumata*, L.] and the clothes moth [*Tineola biselliella*, Humm.], the mustard beetle [*Phaedon cochleariae*, F.], the blossom beetle [*Meligethes aeneus*, F.], the apple blossom weevil [*Anthonomus pomorum*, L.], the pea and bean weevil [*Sitona lineatus*, L.], the hide beetle [*Dermestes maculatus*, Deg.], ants [*Lasius* spp.], wasps and woodlice. The median lethal dosages varied considerably, but were generally lower than those of other insecticides. Considerable acreages of seed-beds have been effectively treated for the control of *P. cochleariae* and *M. aeneus*.

Gammexane acts against insects as a stomach poison, a contact poison or a fumigant, and since these effects may be combined, the investigation of its mode of action is difficult. It may act by blocking the vital reaction dependent on inositol, a molecularly similar metabolite that is widespread in many types of cell, and DDT [2, 2-bis (parachlorophenyl)-1, 1, 1-trichlorethane] possibly acts in the same way, although it has only one-fifth of the power of gammexane.

In experiments on toxicity to vertebrates, the quantities per kg. body weight necessary to produce 50 per cent. kill of rats in seven days when introduced into the stomach were 1.7, 0.19, and 1 gm. of the  $\alpha$ ,  $\gamma$ , and  $\delta$  isomers and 1.25 gm. of the mixture of isomers; the  $\beta$  isomer produced no mortality. Experiments on chronic toxicity showed that rats could be fed with 10, 20 or 30 mg. gammexane per day for five weeks and with 100 mg. of the mixture per day for two months without effect. Rats were not affected when the skin of the tails and ears was painted with an emulsion containing 5 per cent. of the mixed isomers. The subcutaneous injection of 100 mg. gammexane per kg. body

weight killed 25 per cent., the rest being severely affected but recovering in three days; 600 mg. mixed isomers per kg. body weight were injected without producing any effect. Saturated solutions of the  $\alpha$  and  $\beta$  isomers did not affect goldfish, but gammexane was distinctly toxic at a concentration of one part per million. It is concluded that the use of 666 entails little danger to man or the higher animals, though the effect on the skin is not yet known.

ANNAND (P. N.). **Report of the Chief of the Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, 19[42-]43.**—58 pp. Washington, D.C., U.S. Dep. Agric., 1944.

An account is given of work on insect pests and their control in the United States during the year ending 30th June 1943, some of which has already been noticed. Micronised phenothiazine again gave good control of the codling moth [*Cydia pomonella*, L.] on apple in field tests [cf. R.A.E., A 31 464], and in the Pacific Northwest, the development of improved adhesives enabled the dosage to be reduced from 2 to 1 lb. [per 100 U.S. gals.] without reduction in control. Furthermore, mixtures of phenothiazine and lead arsenate, each at half the normal dosage, gave satisfactory control, and it was found that phenothiazine could be substituted for lead arsenate in the early cover sprays. The deleterious effect on the size and colour of the fruit was still evident, however. In the Hudson Valley, synthetic cryolite was less effective than lead arsenate and caused severe cracking of the fruit. Prior to its discovery in California in 1942 [32 114], the known range of the oriental fruit moth [*Cydia molesta*, Busck] in the United States was confined to the east and to the south as far west as Kansas, Oklahoma and Texas. A survey of the western half of the country was begun in 1943 and disclosed a newly infested area extending from north-eastern Texas through Oklahoma, eastern and east-central Kansas and south-eastern Nebraska into southern Iowa. Comstock's mealybug [*Pseudococcus comstocki*, Kuw.] extended its range in 1942 and caused heavy damage to apple in northern Virginia and Connecticut; it was also injurious in several orchards in Ohio and New Jersey. It was scarce in the older infested areas of Virginia, West Virginia and Ohio in the spring of 1943 owing to the activity of imported parasites [31 464] and the work of a native fungous disease [32 122] during prolonged rains in late summer and autumn. The spraying campaign against the pear psylla [*Psylla pyricola*, Först.] carried out in the Pacific Northwest during recent years was continued. It appears to have eliminated this Psyllid from several orchards, and only minor extensions of the infested area were reported in 1942, though infestation became severe in Okanogan County, Washington, in the autumn. Ammonium sulphamate effectively destroys the stumps and suckers of infested trees [33 22]: it is easily applied and, unlike other sprays used for this purpose, is not injurious to the soil. Further information on the occurrence of *Parlatoria chinensis*, Marl., in St. Louis, Missouri [cf. 31 464] indicated that it was generally distributed over much of the city. It was also found in three counties in southern California, where, however, it was confined to *Ficus* spp. Laboratory and field tests in St. Louis indicated that commercial control of this Coccid can be obtained by dormant or delayed dormant sprays containing 3 or 4 per cent. lubricating oil, paraffin-base oils and quick-breaking emulsions being the more effective. The efficiency of oil emulsions at low concentrations was greatly increased by the addition of cubé resins or dinitro-ortho-cyclohexylphenol.

In an investigation of the insect-proof qualities of packages for dried fruit, it was found that newly-hatched larvae of the Indian meal moth [*Plodia interpunctella*, Hb.] and the confused flour beetle [*Tribolium confusum*, Duv.] can penetrate crevices 0.12 mm. in width, and that larvae of the saw-toothed grain beetle [*Oryzaephilus surinamensis*, L.] can pass through crevices 0.16 mm. wide. Experiments in Ohio indicated that infestation by the grape-berry moth [*Polychrosis viteana*, Clem.] can be halved in one season by cultural methods,

the most effective of which is to expose the cocoons in autumn by ploughing the soil so that it forms a ridge under the vines and to cover them in spring by flattening the ridges with a power hoe and ploughing along the centres. In work on fumigation with hydrocyanic acid gas against the California red scale [*Aonidiella aurantii*, Mask.] on *Citrus* [cf. 32 9] a tent of canvas treated twice with a plastic was found to retain the fumigant almost as well as a gas-tight box. Oil sprays applied for the control of the black scale [*Saissetia oleae*, Bern.] on *Citrus* in California caused high mortality of the immature stages of its parasite, *Metaphycus helvolus*, Comp., whereas fumigation with hydrocyanic acid gas did not.

In experimental plots of rubber-producing plants, golden-rod [*Solidago*] and kok-saghyz [*Taraxacum kok-saghyz*] were infested by thrips, Jassids and white grubs [*Lachnosterna*], and these are regarded as potential pests of large-scale plantings; nurseries and plantations of guayule [*Parthenium argentatum*] in California and Texas were attacked by various insects [33 104], including Tenebrionids, which were controlled among seedlings over an area of 200 acres by the application of a poisoned bran bait.

The vetch Bruchid [*Bruchus brachialis*, Fhs.] was found to be present in areas of northern Georgia, Alabama and Mississippi where hairy vetch [*Vicia villosa*] is grown for seed and its occurrence in north-western Idaho and eastern Washington, where it was first recorded in the previous year, was confirmed; it has greatly reduced seed-production in the South Atlantic States and causes serious injury in the Willamette Valley, Oregon. Grasshoppers continued to decrease in numbers; nymphal populations in observation areas were 54 per cent. lower in 1942 than the average for the previous six years, and adult and egg populations showed reductions of 30 and 47 per cent., respectively. A mixture of cottonseed hulls or new or old sawdust with mill-run bran (3 : 1) or whole wheat flour (15 : 1 or 20 : 1) was an effective substitute for bran in field tests of baits against grasshoppers, as was moistened or oiled steam-rolled wheat in baits [cf. 32 134] against the Mormon cricket [*Anabrus simplex*, Hald.]. Larvae of white-fringed beetles [species of the subgenus *Graphognathus* of *Pantomorus*] were more injurious to field and garden crops in Alabama early in 1943 than in any year since 1937. During the previous five years, they were most numerous in fields in which ground-nuts or intercropped maize were grown. In cage tests, survival of the larvae was much lower in the heavy soils near New Orleans than in lighter soils in other parts of the infested area and varied with the amount of humus present, although they survived for a long time in soil containing very little. Damage to crops was lower where heavy vegetation had been ploughed in than in more barren soils.

In work on the fumigation of stored grain and cereals, hydrocyanic acid gas, methyl bromide and other fumigants in general use were not harmful to vitamin B<sub>1</sub> (thiamine chloride) in enriched flour, but methyl bromide, chlorpicrin and carbon bisulphide applied at the recommended concentrations all materially reduced the viability of wheat with a moisture content above 12 per cent. Methyl bromide was successfully used to fumigate railway waggons prior to loading them with flour to destroy any insects that might be present, and after loading, to destroy the insects that flew into them during the process. The dosage was 6 lb. per waggon.

Losses of field and sweet maize due to the European corn borer [*Pyrausta nubilalis*, Hb.] were heavier in 1942 than in any previous year in the United States. The moth extended its range to the westward, and was recorded in north-eastern Missouri for the first time. Infestation in eastern Iowa [31 341] increased rapidly in 1943. Work on varietal resistance of sweet maize in 1940-42, indicated that some improvement in resistance to *P. nubilalis* can be obtained by breeding from individual plants selected within inbred lines homozygous for other characters. Four imported parasites of *P. nubilalis*

[cf. 31 406] were abundant in certain environments and are likely to become of importance in control; parasitism was as high as 40 per cent. over fairly large areas in the north-eastern States, and distribution is being continued. Experiments in Idaho showed that sweet maize grown for seed can be protected from the corn earworm [*Heliothis armigera*, Hb.] by a single application to the ears of mineral oil containing pyrethrum extract, despite the long period for which they are exposed to attack.

Field investigations in Louisiana of measures against the sugar-cane borer [*Diatraea saccharalis*, F.] terminating in 1942 showed that excellent control is given by cryolite dust applied four times at weekly intervals during the hatching periods of the first or second generations [cf. 32 236]. Infestation in southern Florida in 1942 was lower than usual, apparently owing to heavy parasitism by *Lixophaga diatraeae*, Tns., *Metagonistylum minense*, Tns., and *Agathis (Bassus) stigmatera*, Cress., in 1941, when total parasitism at one place reached 68 per cent. A local infestation of sugar-cane by *Tarsonemus bancrofti*, Michael, at Canal Point, Florida, was apparently eradicated by destroying infested canes or treating them with hot water. This mite was not known to occur elsewhere in the United States.

In work to determine how available insecticides can best be utilised under war-time conditions, a dust mixture containing 0.375 per cent. rotenone, 1.7 per cent. nicotine and 10 per cent. sulphur [cf. 31 400] was as effective against the pea Aphid [*Macrosiphum onobrychis*, Boy.] as one containing 0.75 per cent. rotenone and was successfully used on a commercial scale. This mixture did not control cabbage caterpillars, but the addition of nicotine to pyrethrum dusts increased their effectiveness against the diamond-back moth [*Plutella maculipennis*, Curt.]. Organic thiocyanates were of no value against the Mexican bean beetle [*Epilachna varivestis*, Muls.] either alone or when incorporated in rotenone dusts, but micronised phenothiazine was sufficiently promising to justify further investigation. The effectiveness of dust mixtures containing rotenone varied directly with the rotenone content of the powdered derris root employed and the amount of the latter applied per unit area and inversely with the size of its particles. It was found that a spray of sodium fluosilicate and sugar can be used to supplement rotenone dust against the pea Bruchid [*Bruchus pisorum*, L.] on Austrian peas, and basic copper arsenate was as effective as calcium arsenate against the Colorado potato beetle [*Leptinotarsa decemlineata*, Say]. Plant bugs that attack the seed balls of sugar-beet [cf. 32 216] are best controlled by dusts of pyrethrum and sulphur, but sulphur alone was found to be satisfactory in Arizona.

Work in the Yakima Valley, Washington, showed that six or seven applications of sprays of calcium arsenate or cryolite are necessary to protect potato tubers from damage by flea-beetles [*Epitrix tuberis*, Gentner]; the cost of such treatment is probably justifiable only under war-time conditions. The damage can be reduced by the use of improved drainage, decreasing the application of irrigation water and eliminating small successive plantings. Elsewhere in Washington, there was little difference in the mortality of wireworms [*Limonius*] given by naphthalene applied at rates of 200, 600 and 800 lb. per acre [cf. 33 23]. As a result of studies on the relation of cover crops to wireworm populations in California, planting lima beans in fields of sweet clover [*Melilotus*], which is unattractive to the adults, is recommended; barley, fenugreek [*Trigonella foenum-graecum*] and mustard are preferred for oviposition in spring.

In experiments against the boll weevil [*Anthonomus grandis*, Boh.] in Mississippi, dusting the plants from the ground or from aircraft with calcium cyanamide at the rate of 10-30 lb. per acre, caused all the leaves and squares to be shed within 3-6 days. In addition to forcing the adults to enter hibernation in a starved condition [cf. 32 403], this operation also prevents staining of the lint by leafworms [*Alabama argillacea*, Hb.] and Aphids, improves the quality

of the lint gathered by mechanical harvesters and facilitates hand-picking. *Aphis gossypii*, Glov., was collected on 13 wild and cultivated plants during the winter and early spring in Louisiana; it was first observed on cotton on 15th April, was accompanied by *A. medicaginis*, Koch, *Myzus persicae*, Sulz., and *Macrosiphum solanifolii*, Ashm., during May, and was the only Aphid found on this crop after the middle of June. The pink bollworm [*Platyedra gossypiella*, Saund.] was abundant on cotton in the lower Rio Grande Valley in 1942, owing to high overwintering populations and favourable conditions, and extended its range, mostly by migration from early to later crops; the desirability of adopting uniform planting dates over a given area is emphasised. Emergence from infested bolls collected in August 1942 was completed in the same year, but 9 per cent. of those collected in September and 12 per cent. of those collected in October did not give rise to adults until after 1st February 1943. Three times as many larvae survived the winter in bolls on the surface of the soil as in buried bolls. Populations of larvae on secondary malvaceous food-plants [cf. 32 57] were the highest yet recorded; they were most numerous after the cotton had matured, and it is possible that under certain conditions the insect may survive from one crop to the next on them. In the Big Bend area of Texas, infestation in late August was higher in 1942 than in 1941, but overwintering populations were reduced by floods. A total of 177,000 examples of the Japanese egg parasite, *Chelonus pectinophorae*, Cushman, [cf. 30 593], was released in cotton fields during the season, and four shipments of cocoons of *Bracon* (*Microbracon*) *vulgaris*, Ashm., were received from Brazil. The percentage survival of overwintering larvae of the bollworm [*Heliothis armigera*] in cages in Texas was only 0.4, as compared with 23 in the previous year. Low humidity was again found to be of less importance than high temperature in preventing the eggs from hatching. *Alabama argillacea* was first observed near Brownsville, Texas on 13th April in 1942, the earliest date on which it has been recorded. It spread slowly at the beginning of the season, but by late August it was present in the western and northern cotton-growing areas, where it caused most damage; damage elsewhere was only local. In experiments on the control of the cotton fleahopper [*Psallus seriatus*, Reut.] in Texas, dust mixtures of basic copper arsenate and sulphur applied to dry plants at mid-day were as effective as the standard dust of calcium arsenate and sulphur applied early in the morning and more effective than standard or micronised sulphur applied alone or with calcium arsenate at mid-day. In the absence of arsenicals, sulphur can be satisfactorily used alone against this Capsid.

Parasites imported into the United States during the year included *Triaspis vestitica*, Vier., and *Bracon* (*Microbracon*) *vestitica*, Vier., from Peru against *Anthonomus grandis*, *Lixophaga diatraeae* from Cuba against *Diatraea saccharalis*, *Lydinolydella metallica*, Tns., from Brazil against *Epilachna varivestis*, *Porizonidea* (*Porizon*) sp. from Argentina against the vegetable weevil [*Listroderes obliquus*, Gylh.], and *Ephialtes* (*Ichneumon*) *caudatus*, Ratz., and *Cryptus sexannulatus*, Grav., against *Cydia pomonella*. Four consignments of adults and larvae of the predacious Elaterid, *Pyrophorus luminosus*, Ill., were received from Porto Rico and released in southern Florida against Lamellicorn larvae on sugar-cane. A consignment of *Plaesus javanus*, Erichson, imported from Fiji was shipped to Honduras for liberation against stem-feeding grubs [*Cosmopolites sordidus*, Germ., on banana]. *Aphelinus mali*, Hald., was sent to Mexico for use against the woolly apple aphid [*Eriosoma lanigerum*, Hsm.], and *Eretmocerus serius*, Silv., an effective parasite of the citrus blackfly [*Aleurocanthus woglumi*, Ashby] originally imported from Malaya, is being shipped from the Panama Canal Zone for use against this Aleurodid on the west coast of Mexico.

Chemical investigations on insecticides are briefly reviewed. It was found that methyl chloride, propane or butane can be used to replace part of the dichlorodifluoromethane in pyrethrum aerosols for some purposes [cf. 33 99].

NEISWANDER (R. B.). **Insect Pests of Strawberries in Ohio.**—*Bull. Ohio agric. Exp. Sta.* no. 651, 37 pp., 15 figs., 26 refs. Wooster, Ohio, 1944.

Nearly half this paper is concerned with *Ancyliis comptana*, Froel. (*fragariae*, Walsh & Ril.), which has caused economic injury to strawberries in Ohio since 1934. An account is given of its bionomics [cf. *R.A.E.*, A 26 735], and of observations in 1935–43 on the effectiveness of parasites of the larvae. A list is given of the 22 primary and three secondary parasites reared. The percentage parasitism varied in different broods and from year to year, but was not sufficient to afford commercial control. *Macrocentrus ancyliivorus*, Rohw., and *Cremastus cooki*, Weed [cf. *loc. cit.*], which were released in large numbers in strawberry plantings in 1935–42 and 1939–41, respectively, together accounted for about 70 per cent. of the total parasitism. Experiments on control carried out in 1936–43 [cf. *loc. cit.*] are described. It is concluded from the results that when the leaf-roller population reaches damaging proportions, commercial control can be obtained by treating plants set the same season with a dust of cryolite, talc and flour (1 : 2 : 2) or sprays of 5 lb. cryolite per 100 U.S. gals. water or 4 lb. lead arsenate and  $\frac{1}{2}$  U.S. gal. summer oil per 100 U.S. gals., both with a spreader, three times at weekly intervals from about 20th August to destroy the larvae that hibernate. If this has not been done and damage by the spring generation is anticipated, the same treatments should be applied two or three times at weekly intervals from the time when the first eggs hatch, usually early in May. At least two weeks should elapse between the last application of cryolite or lead arsenate and the first picking; if an insecticide is needed when the fruit is ripening, a spray of 1 gal. summer oil and  $\frac{3}{8}$  pint nicotine sulphate per 100 gals. or a dust containing 0.5 per cent. rotenone can be used.

As a result of experiments described, the measures advocated against the strawberry leaf beetle, here called *Paria* sp. [cf. 30 537], include planting new beds at a distance from old plantings or woodland, in which the adults hibernate, and applying the dusts previously recommended [*loc. cit.*] three times at weekly intervals from the beginning of August if infestation develops. *Colaspis brunnea*, F., which is said to overwinter as a partly grown larva [cf. *loc. cit.*], can be controlled with the same dusts; one of lead arsenate and lime (4 : 50) gave effective control in 1939. *Tyloderma fragariae*, Ril., has not caused widespread damage to strawberry in Ohio in recent years, though it destroyed one planting in 1942. Its bionomics, which are described, resemble those recorded from Kentucky [26 736], and similar control measures are recommended. White grubs [*Lachnosterna*] are among the major pests of strawberry plants, feeding on the roots and often cutting the plants off just below the crown. They have a three-year life-cycle and are most injurious to plants set on newly ploughed sod. In 1928, a strawberry bed was injured by larvae of *Euphoria inda*, L., which has a life-cycle of one year, but this Cetoniid is seldom abundant enough to cause trouble. To prevent damage by white grubs, strawberries should not be planted on newly ploughed sod or in any field where the grubs are abundant. In areas where injury occurs in spite of these precautions, the soil should be treated with lead arsenate applied evenly at the rate of 5–10 lb. per 1,000 sq. ft. of surface and mixed with the upper layer, or to strips 1 ft. wide at the rate of 5–10 lb. per 1,000 ft. of row, the plants being set in the middle of the treated strips. In tests in an uninfested field, plants grown in this way were less vigorous than others early in the season, and a few were killed, but the entire planting was in good condition at the end of the season.

The Cercopid, *Philaenus leucophthalmus*, L., damaged strawberries in eastern Ohio in 1940. The frothy masses with which the nymphs are covered were observed on more than half the plants in early June, 1–12 nymphs being found in each mass, many of the nymphs had transformed to adults by mid-June, and most of the frothy masses had disappeared by 1st July. A thorough dusting with powdered derris root in talc (0.5 per cent. rotenone) on 8th June caused

87 per cent. mortality of the nymphs by 14th June. Other pests that occasionally attack strawberry in Ohio include the mites, *Tetranychus bimaculatus*, Harvey, and *Tarsonemus pallidus*, Banks; the Lygaeid, *Myodochus serripes*, Ol. [cf. 30 538], which has at least two generations a year but is abundant only in July and August; the leaf-rollers, *Tortrix* (*Cacoecia*) *rosaceana*, Harr., *T. (Amelia) pallorana*, Rob., *Sparganothis sulfureana*, Clem., *Argyroplote* (*Olethreutes*) *cespitana*, Hb., and *Platynota flavedana*, Clem., and the sawflies, *Empria maculata*, Nort., and *E. ignota*, Nort., which can be controlled by the sprays and dusts recommended against *Ancylys comptana*; the weevils, *Anthonomus signatus*, Say, and *Otiorrhynchus* (*Brachyrrhinus*) *ovatus*, L.; the Aphid, *Cerosipha* (*Aphis*) *forbesi*, Weed, which feeds on the newly developed strawberry leaves in spring and is carried to the roots by ants; and cutworms, which are usually abundant in newly ploughed sod and can be controlled by means of poison baits.

KNOWLTON (G. F.). *Orius feeding Records*.—*Bull. Brooklyn ent. Soc.* 39 no. 3 pp. 84-85. Lancaster, Pa., 1944.

Records are given of insects, chiefly Aphids and thrips, on which *Orius tricolor*, White, and *O. insidiosus*, Say, were observed to feed in the field in Utah.

KNOWLTON (G. F.). *Some Insect Food of the Chickadee*.—*Bull. Brooklyn ent. Soc.* 39 no. 3 p. 85. Lancaster, Pa., 1944.

Lists are given of the insects found in the stomach contents of six long-tailed chickadees (*Penthestes atricapillus septentrionalis*), collected from hawthorn and chokecherry or near willow in Utah in September 1940. They comprised well over 4,000 Aphids and about 70 other insects.

MONTE (O.). *Crítica sobre alguns gêneros e espécies de Tingitídeos*. [Criticism of some Genera and Species of Tingids].—*Papéis avulsos Dep. Zool.* 2 no. 6 pp. 103-115, 3 figs., 23 refs. São Paulo, 1942. (With a Summary in English.) [Recd. 1945.] *Notas sobre um percevejo, praga de várias solanáceas cultivadas*. [Notes on a Bug injurious to various cultivated Solanaceae].—*Biológico* 9 no. 5 pp. 113-120, 1 pl., 1 fig., 9 refs. São Paulo, 1943.

In the course of the first paper, the author agrees with Stål (1873) that *Corythaica cyathicollis*, Costa, of which the type has since been lost, is a synonym of *C. monacha*, Stål. *C. passiflorae*, Berg, is a distinct species, and *C. planaris*, Uhl., a synonym of it; *C. cyathicollis* had previously been considered an earlier name for both.

In the second paper, he briefly recapitulates his conclusions as to the synonymy of *C. passiflorae* and *C. monacha*, and describes all stages of the former. These two Tingids have been confused in the literature, and records of *C. monacha* as a pest of egg-plant (*Solanum melongena*) in Porto Rico [R.A.E., A 5 559] and of tomato in Brazil [16 683; cf. also 31 119] refer to *C. passiflorae*. The latter is the more widespread and injurious. It has been recorded not only from Porto Rico, but also from Cuba and the whole of South America, with the exception of the countries on the Pacific coast (Chile, Peru and Ecuador), and the author has material from Costa Rica, collected on *Solanum torvum*. *C. monacha* is much more restricted in distribution; it occurs in Brazil and is here recorded for the first time from Venezuela, on *Sida rhombifolia*.

Lists are given of the food-plants of six species of *Corythaica*. *C. monacha* occurs on malvaceous plants of the genus *Sida* and on a species of *Richardia*. *C. passiflorae* was described from *Passiflora coerulea* in Argentina, but it has

since been found only on tomato and various wild and cultivated species of *Solanum*. In experiments, it did not become established on tobacco. In Brazil, it is a pest of tomato, potato, *Solanum melongena* and *S. gilo*, causing the most injury to the first two. Its appearances are sporadic. It develops entirely on the leaves, preferring the lower surfaces; in experiments, the egg and nymphal stages lasted 6 and 10-12 days, respectively. The eggs are parasitised by *Anaphes tingitiphagus*, Soares [cf. 31 119]. The bug can be controlled by sprays containing nicotine and soap.

GARDNER (J. C. M.). **A Note on the imported Lantana Bug** (*Teleonemia scrupulosa* Stål).—*Indian For.* 70 no. 5 p. 139. Dehra Dun, 1944.

On the receipt of a consignment of *Teleonemia scrupulosa*, Stål, from Australia [cf. R.A.E., A 31 45], cage tests were begun at Dehra Dun to ascertain whether it would be likely to be of value against *Lantana* under the climatic conditions it would encounter in India and whether it might attack plants of economic value there, notably teak, which belongs to the same family (Verbenaceae) as *Lantana*. The tests, which were continued for three years, showed that the bugs preferred *Lantana*, and especially its flowers, to any other plant offered. When teak and *Lantana* were grown together in a cage, the bugs remained on the *Lantana* until it was defoliated, but then migrated to the teak leaves, on which they fed and reproduced more slowly. They did not cause appreciable injury to the leaves, but might well do so to the flowers. Their effect on teak flowers could not be assessed under cage conditions, but it was found that they tend to ascend stems and therefore reach the flowers eventually, after which they continue to feed on them. It was therefore considered inadvisable to liberate the bug unless future tests should prove that teak flowers are not seriously affected.

#### PAPERS NOTICED BY TITLE ONLY.

SWEZEY (O. H.). **Keys to some Lepidopterous Larvae found in Gardens and Homes in Hawaii**.—*Proc. Hawaii. ent. Soc.* 12 no. 1 pp. 138-145, 37 figs. Honolulu, 1944.

HASTINGS (E.) & PEPPER (J. H.). **The fatty Materials in diapausing Codling Moth Larvae** (*Carpocapsa* [*Cydia*] *pomonella* L.).—*Arch. Biochem.* 4 no. 1 pp. 89-96, 9 refs. New York, N.Y., 1944.

GOODHUE (L. D.). **New Developments in Insecticides** [a review of the literature].—*Iowa St. Coll. J. Sci.* 19 no. 3 pp. 255-262, 33 refs. Ames, Iowa, 1945.

STIFF jr. (H. A.) & CASTILLO (J. C.). **A colorimetric Method for the Micro-determination of 2, 2, bis (p-chlorophenyl) 1, 1, 1 trichlorethane (DDT)**.—*Science* 101 no. 2626 pp. 440-443, 1 graph, 5 refs. Lancaster, Pa, 1945.

WINTERINGHAM (F. P. W.). **The Sorption of Ethylene Dichloride by Wheat Products**.—*J. Soc. chem. Ind.* 63 pp. 144-150, 2 figs., 8 graphs, 6 refs. London, 1944.

WINTERINGHAM (F. P. W.). **The Determination of residual Ethylene Dichloride in fumigated Wheat Products**.—*J. Soc. chem. Ind.* 63 pp. 359-363, 1 fig., 6 refs. London, 1944.

## NOTICES.

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